Railway Mechanical Engineer

Volume 99 DECEMBER, 1925 No. 12

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SCHEDULED FOR NEXT MONTH

You will be interested in the new TEXAS TYPE LOCOMOTIVE. It will be described in next month's issue.

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Railway Mechanical Engineer

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Order your index now

The current volume of the *Railway Mechanical Engineer* closes with this issue. Only a sufficient number of indexes will be printed to supply copies to those of our readers who specifically request that a copy be sent them. If you want the index, therefore, place your order now, mailing it to our New York office, 30 Church street, New York.

Using the Railway Mechanical Engineer

Several preceding issues have contained in these columns suggestions of ways in which the *Railway Mechanical Engineer* may be made useful to mechanical department officers and foremen. These have dealt largely with what may be called organized or group utilization. The greatest value of the paper, however, comes to the individual subscriber whose reading habits lead him to scrutinize each issue as it is received so that he may be sure he has not missed any article dealing with a subject in which he is concerned, before he finally lays it aside. Just to illustrate, have you ever encountered difficulty in the maintenance of old Vanderbilt tanks? This issue tells you how one railroad has overcome this condition. Has the problem of effective staff meetings ever given you concern? In this issue you will find suggestions—in two places—on how not to handle staff meetings as well as on how they have been conducted successfully. Did it ever occur to you that the location of the whistle on the locomotive is a matter of importance? Are you satisfied with the present situation with respect to the transfer of lading from bad order cars? Are you interested in the application of the newly developed lacquer process to passenger coach finish? Is the matter of die construction for forging machines one with which you are concerned? If you are interested in these and many other questions pertaining to mechanical department affairs, do not fail to make full use of the *Railway Mechanical Engineer* by reading what others have accomplished in solving, or have to say concerning, these problems, in this issue.

Getting the most out of power hacksaws

Every machine tool is limited in production by the cutting tools that are used on it. Practically all types of machines have been developed to the maximum feeds and speeds that it is possible to obtain with the cutting tools now on the market. Much greater production could be obtained with practically every machine tool if it were possible to secure tools that would stand up under a heavier cutting schedule. Power hacksaw machines have probably been handicapped more than any other machine tool in this respect, because the manufacturer of hacksaw blades has lagged considerably behind the development of other cutting tools. As a result, some users do not consider the power hacksaw as a machine tool and will not give it the same study and consideration necessary to improve the production possible to obtain from it. In many shops, the cheapest kind of labor is used on these machines. They are not always kept in good repair, nor are they properly cleaned. Furthermore the cutting-off operations of which these machines are capable, are not given the same careful consideration which is given the milling, drilling or grinding machine. The purchase of hacksaw blades is often based on price alone. A careful study of a power hacksaw machine shows that it has many advantages over other types of cutting-off machines. It requires less power, is quicker to operate and requires less time to stop, move up the work and start again; the blade expense is less, it removes a much narrower kerf and the initial investment is much smaller. In the past there have been two objections to a machine of this type which have been overcome during the past two years; namely, blade breakage and crooked cutting. A modern power hacksaw will not break blades as long as the machine is in good condition, provided it is running at the correct number of strokes per minute and that the blades are of the correct specifications for the material being cut. Within the past year, several types of hacksaw blades have been placed on the market which are capable of utilizing the maximum capacity of a modern power hacksaw machine. A modern machine of this type represents a capital investment and should receive the same consideration as any other machine tool, in order that it may earn the greatest possible return. It should be properly maintained and consideration should be given to the selection of the blades which will utilize the capacity of the machine.

Possibilities of standard small tools

A great lack of uniformity exists in the small tools used for similar operations, not only in railroad shops and enginehouses on different railroads, but in the various shops and terminals on the same road. The arguments in favor of a certain amount of standardization of these tools are well known, consisting primarily of reduced cost to manufacture, consequent lower possible selling cost, and reliable products more uniformly adapted to perform the manifold operations in repairing cars and locomotives.

The American Railway Tool Foremen's Association took a step in the right direction at its convention last September when a regularly appointed committee of the association submitted for adoption certain general specifications for standard locomotive frame and rod reamers. The variation in reamer sizes, flute lengths, taper, spiral angle, type of shank, and one or two minor details were specified, and, after some discussion, the association voted to recommend the proposed reamers to the Mechanical

Division for consideration at the Atlantic City convention next June. If adopted as standard by all the roads, the result will be to reduce materially the number of kinds of taper reamers used in railroad shops and enginehouses. The Tool Foremen's Association is to be congratulated on its work in connection with these reamers, particularly in view of the well-known difficulty in getting any body of mechanical men to develop a standard design which will meet satisfactorily the varying needs of all the individual members.

Another tool which is under consideration for standardization by the Tool Foremen's Association at next year's convention is the boiler tap, and the problem of what general specifications to adopt in this case is complicated by the difference of opinion regarding the relative merits of Whitworth and V-type threads for boiler work. It would seem reasonable to assume, however, that one of these threads is in general superior to the other and the better one of the two ought to be adopted on all the railroads in the country. The manufacturers could then increase their production of that particular type of boiler tap and with the use of specialized high production machinery and methods turn it out at decreased cost.

This work of reducing to a certain extent the multitudinous variety of shop tools, and particularly the great number of expensive special tools used by individual roads, may well be encouraged and extended. With judgment in the determination of what tools can be properly standardized without a deadening effect on the development of new and improved tools, it will save the railroads money and prove advantageous to all concerned.

Mechanical department staff meetings

Few, if any, railroads carry out the idea of holding annual mechanical department staff meetings to the extent practiced on the Chicago, Milwaukee & St. Paul, under the direction of L. K. Sillcox, general superintendent of motive power. That the value of the meetings in the way of inspiration, education and the promotion of better feeling and unified action on the part of the mechanical department supervisory officers, more than justifies the effort and cost involved seems to be well established by experience on the St. Paul. In fact, since the inauguration of the staff meeting plan four years ago, the meetings have increased in size and importance, the men working harder each year in preparation for them and being more enthusiastic each year about the results accomplished.

The 1925 staff meetings began with that of the general, blacksmith and tool foremen held at Milwaukee, Wis., June 8 to 10, inclusive, at which 24 papers on selected subjects were read and discussed. Following this meeting within a period of two months, the air brake foremen met for a two-day session and discussed standard practices for the maintenance of air brakes, the meeting being divided as between the locomotive and car departments; traveling engineers from all over the system held a two-day session at which 16 papers were presented; the boiler foremen met in Minneapolis for a three-day session at which 17 papers were presented; the chief clerks, also divided as between the locomotive and car departments, met for a two-day session, in each case considering 10 subjects; the master mechanics held a three-day session, discussing 19 subjects; the car department also held a three-day session at which 20 papers were presented. The last of these meetings was held at Milwaukee, October 12 to 13, at which special apprentices discussed 17 papers pertaining to their work.

The mechanical department officers from the entire system so far as possible, attend these meetings, which are scheduled in such a way that the maximum number of men can be in attendance without interfering with service and the normal functioning of the mechanical department. Mimeographed copies of the papers prepared in advance are available to the members before attending the meetings and this enables a more studied and careful discussion to be maintained. A record of the discussion is kept which also subsequently becomes available to the men interested for further study and guidance in their work during the coming year. Unquestionably, the mechanical department staff meetings as held on the Chicago, Milwaukee & St. Paul, have had a most helpful influence in assisting the mechanical officers to understand their mutual problems better, in improving the acquaintance of these men and welding them into a unit in the furtherance of the better interests of the railroad they serve.

Utilizing shop schedules

Due to the varied nature of locomotive shop work it has always been more or less difficult to compile figures which will serve as a true indicator of shop production or output. To say that a locomotive shop turns out so many classified repairs in a given month is not by any means a sound basis for comparison of output, neither is a comparison of man-hours always a true indicator of production.

Several large locomotive shops in this country have, however, developed systems along with their shop scheduling systems which serve as a reasonably accurate indicator of output. These have been fully described in past issues of the *Railway Mechanical Engineer*, and it is sufficient to point out here that one such system is based on the principle of allotting a certain number of points for each locomotive which has been given classified repairs, the number of points depending, in general, upon the class of repairs, due consideration being given to the type of locomotive and whether repairs in a given class are light or heavy. With this system it is possible to determine the number of man-hours required to make a point, and a comparison of these figures serves to furnish at least a consistent basis of comparison of output.

In one shop using such a system a keen spirit of rivalry became apparent between different gangs which resulted in many original ideas being brought out to save time and labor on many jobs which were formerly done in a less efficient manner. The foremen throughout the shop are periodically furnished with reports showing the progress being made during the month, and in an effort to produce "points" with the least possible number of man-hours, every element of machine and erecting shop practice entering into production is carefully watched. In this manner many machine tools in that shop which had been rendering service for a great number of years were found to be the real reason why it was impossible to make a substantial reduction in man-hours on certain jobs. This led to the making of time studies on such machines in comparison with more modern machines recently installed for the same class of work with the result that those in charge of the shop were able to present to the management some real figures showing why new machine tools should be purchased.

Is it not possible that one of the reasons why many shops must get along with inadequate machine tools is because there has been no systematic effort made to find out just how much could be saved by the installation of more modern tools?

Locomotive shop scheduling systems were originally developed with the idea of increasing output. Some shops which have gone a little farther than others in develop-

ing the details of scheduling systems have found that it is possible to secure reliable data on many phases of shop operation which not only make it easier to perform the ordinary repair work but also furnish a comprehensive basis for the requisition of new machine tools and shop equipment.

Front end draft appliances

Railroad mechanical men don't need to be told that the arrangement of draft appliances in the front end has an important bearing on locomotive performance. Not every one realizes, however, that it is almost impossible to over-emphasize the importance of this feature of locomotive design. The fuel savings made possible by modern locomotive design and the incorporation of various auxiliary fuel economy devices can be completely nullified by improper arrangement of the draft appliances in the locomotive front end.

A striking example of necessity of front end adjustment to suit individual conditions was afforded by the tests of Missouri Pacific three-cylinder Mikado locomotive 1699 at the Altoona test plant, as reported on page 462 of the July, 1925, *Railway Mechanical Engineer*. When this locomotive was placed on the test plant it was believed that with proper combustion an evaporation of 59,000 lb. of water an hour could be obtained, but, on the first trial with a 6¼-in. exhaust tip, the evaporation proved to be only 48,000 lb., or almost 19 per cent less than was expected. The exhaust tip was then increased to 6½ in. and the stack fitted with an extension to within 15 in. of the nozzle. No improvement was obtained with this arrangement. A Pennsylvania Lls stack was then applied with the same 6½-in. exhaust nozzle and a basket bridge, and an evaporation of 46,440 lb. of water an hour obtained. In order to fill the stack, the exhaust nozzle was then increased to 7 in. in diameter, the basket bridge being retained and an evaporation of 55,000 lb. an hour then resulted.

The final change was to use a 7-in. tip with Goodfellow projections, this arrangement bringing the evaporation up to 59,900 lb. an hour and later to 61,680 lb. Retaining the 7-in. tip with Goodfellow projections the original front end arrangement was replaced except for the petticoat pipe and the evaporation immediately dropped.

It is obvious that thorough-going tests must be made to determine what draft arrangement in the front end will produce the best results. Otherwise locomotives will waste fuel probably in sufficient amount to counterbalance anticipated savings from the application of superheaters, feedwater heaters, brick arches, syphons and other fuel saving devices. Not only is it essential that the dimensions, proportions and arrangement of draft appliances in the front end be suited to each particular class and possibly to each locomotive, but steps must be taken to assure that the correct front end arrangement, once established, be maintained.

A master mechanic of a large road was recently asked by his chief what size exhaust tip was being used on a certain class of locomotives handled at his terminal. In reply he stated that it was a 6½-in. tip. The chief asked him if he was sure, and he replied somewhat heatedly in the affirmative. A subsequent check of exhaust tips on eight locomotives of this class indicated that only one had a 6½-in. tip, the exhaust tips on the other locomotives varying from ⅛ in. to ¾ in. in size.

The necessity of giving unceasing attention to the maintenance of draft appliances in locomotive front ends is apparent.

New Books

Principles of machine design. *By C. A. Norman, professor of machine design, Ohio State University.* **710 pages, illustrated.** *5½ in. by 8½ in. Price $6.50. Published by the Macmillan Company, New York.*

This important addition to books in the engineering field covers somewhat more than the average text book on the subject. It teaches not only how to describe and how to design, but it goes further and contains computations carried through in detail for elements or combinations of elements, forming part of a specified whole, in numerous types of machines. Of the 585 illustrations, many are line drawings and photographs of actual machinery which show clearly not only the general make-up, but also good proportions and assemblies. In addition, there are a number of diagrams illustrating theory and computation. Much detail information and many numerical tables, not generally accessible, are included in the book. These will be found a distinct aid to designers and other engineers desiring this data for reference. For the practicing engineer the book furnishes up-to-date standards with regard to riveting, screws, sprockets, gears, etc., and also gives a collected and fairly simple treatment of modern experience and research, both here and abroad, regarding such matters as wear factors for gears, design of helical gears, belt action, belt loads, laws of lubrication, bearing loads, pressure drop in pipe lines, and other similar problems of design.

What Our Readers Think

The evaporative capacity of locomotive boilers

Philadelphia, Pa.

To the editor:

Our present knowledge of boiler performance must be largely based on empirical data and moreover we are only concerned with such performance for a definite range of operation. From this point of view, simplicity in formula giving a good approximation is the most desirable. On the other hand, aside from mere satisfaction, research or fundamental advance in design demands approaching the phenomena from the most rational basis irrespective of the complications, provided some sicplicity can be obtained in the ultimate results. Considering, however, the flexibility in design as to heating surface, etc. With resulting good efficiencies and the precision of measurements for this kind of work, it is clearly seen that boiler performance at best can only be approximated. Therefore, the degree of refinement in the analysis must keep this concept always in view.

Equation *6* in the first part of Mr. Poperev's article, published in the August issue of the *Railway Mechanical Engineer*, appears logical and his arrangement in the subsequent equations showing the nature of the losses is, all told, a valuable contribution. It is to be noted, however, that various coefficients of the equation are only applicable to one particular boiler of a given type. In the subsequent work, however, Mr. Poperev attempts to correlate these coefficients to account for the various proportions, detail geometrical configurations, types, etc., found in the boilers examined, in the forms of curves or definite functions, the primary variable being the ratio of the heating surface H to grate area G. This is, in my

opinion, exactly the weak spot of his analysis, because there is considerable flexibility in the coefficients proportional to the losses for different ratios of H/G depending upon the configuration and location of the particular percentage of the heating surface, relative firebox volume, etc. It is admitted the ratio H/G is an important constant characterizing the performance of a boiler, provided, of course, boilers of nearly the same configurations are compared. On the other hand, it is equally well recognized that firebox volume to grate surface is of great importance and Mr. Poperev's analysis in no way properly takes this ratio into consideration. Variation in the superheater surface and its configuration in the boiler, the brick arch, length, spacing and diameter of tubes, etc., effect to a more or less degree the efficiency for a given value of H/G. Therefore, the refinement proposed in the analysis is inconsistent with the lack of proper account of the several variables found in the comparison of the various types of boilers.

The formulas proposed by either Dr. Goss or Lawford Fry, appear satisfactory, since they account with sufficient accuracy the performance within the range of operation of locomotives in a much more simple form. Mr. Poperev condemns these formulas, primarily since they do not satisfy limiting conditions, as the initial conditions of zero efficiency at very low rates of combuston, etc. Since, however, we are concerned only with a definite range of operation, it must be admitted, that the simplest equation approximating this particular zone is the most desirable and that a good approximation can be made without necessarily satisfying initial conditions.

Neglecting the error for extremely low rates of combustion which is outside the field of operation, the assumption that the efficiency varies as a linear function of the combustion rate appears sufficiently accurate to account for the actual performance curve of a locomotive boiler. It is to be noted that Mr. Fry's assumption as to the variations of efficiency is in accord with other investigators in the field. Moreover, it would seem that the assumption of a linear function within the range of operating rates of firing is as logical as Mr. Poperev's assumption of a second degree equation for the rate of evaporation to the rate of combustion. Assuming the linear function for efficiency variation, we arrive at a quadratic form for the rate of evaporation to the rate of combustion which satisfactorily accounts for a rate of combustion that may occur within the range of operating firing. With coefficients derived from the efficiency linear equation, the resulting quadratic equation of the evaporation against combustion, fits the actual curves.

Fundamentally, we are concerned with three quantities for estimating and comparing the performance of a locomotive; first, the availability or potentiality of the steam for entrance to the cylinders; second, the efficiency of the card cycle or the cylinder efficiency, and third, finally the efficiency of transference of the heat from the combustion of the coal to the steam in its particular potential form. The latter, the "boiler efficiency," is dependent upon the efficiency of combustion, the magnitude of radiation and the efficiency of heat transference through the tubes. The loss due to combustion, a very important loss, obviously increases with the rate of combustion, but on the other hand, is greatly dependent upon the proportions of the firebox, the proper circulation of air, etc., and probably varying as some inverse function of the volume of the firebox. The radiation in the firebox is of a very uncertain magnitude, some claiming it to be directly proportional to the grate area, others to the firebox surface, etc. It is probably a complex function of both firebox surface, grate area as well as the geometrical configuration and volume of the firebox where in the simple form of the Boltzman Stephan law of radiation must be considerably modified. The availability of heat for transference to the tubes depends at the offset upon the total temperature head of the heated gases and therefore indirectly upon the exact nature of the preceding combustion and radiation phenomena. Then in addition, the heat transmission per unit area of tubes along the tubes depends upon the temperature head for that part, the velocity of the gases through the tubes, the degree of circulation depending upon the spacing of the tubes, etc., and finally on such details as the magnitude of soot, grease, etc., along the tubes. The law of heat transference must be modified for tubes with superheater elements. The cross section area of these to the total tube area is an important ratio for the heat transfer in the tubes.

In conclusion, therefore, it would seem that if a more elaborate method is offered for the analysis of boiler performance, it should consistently be based upon closer physical assumptions, rather than follow the more approximate assumptions used in the older methods which when used in their present forms are sufficiently accurate for the approximate comparisons of performance in which they are ordinarily used. R. Eksergian,

Engineer and technical assistant to the vice-president, Baldwin Locomotive Works.

Is the A. R. A. overlooking a good bet?

Kansas.

To the editor:

In doing a first-class job of getting along, giving better service than ever thought possible, higher wages, higher material costs, increased taxes and other financial burdens are causing the railroads to economize in every phase of the game. The great forum of railroading, the American Railway Association, has done much to promote efficiency and with its seven divisions, the material and tangible side of the question is most thoroughly covered. The by-laws of the A. R. A. provide for the following divisions and prescribe the duties and limits of each: Division I—Operating; Division II—Transportation; Division III—Traffic; Division IV—Engineering; Division V—Mechanical; Division VI—Purchases and Stores, and Division VII—Freight Claims.

Various railroads have departments for helping those outside their own ranks in an educational way and do this through agricultural and industrial departments with competent specialists. Only a small number of the roads have any sort of training for their own mechanical department employees, or have any officer dealing with the human side of railroading. On the roads where this is being considered, personnel departments are doing the human engineering and regularly constituted apprentice departments through their schools are carrying on the educational work. Personnel work on railroads is a comparatively new idea but apprentice training has been successfully tried and proved over a span of two decades. However, there is no medium through which the heads of these departments can meet and work for general betterment in this respect.

The logical place for such a group is within the A. R. A., which association, if it does not believe the subject large enough for a special division, is overlooking a good bet in not having a standing committee in Division V to work out mechanical department educational and personnel problems, bending an effort towards making the 60 per cent of mechanical department expenditures (for labor) more productive, keeping pace with the improvements along all other lines of the business of transportation. Educator.

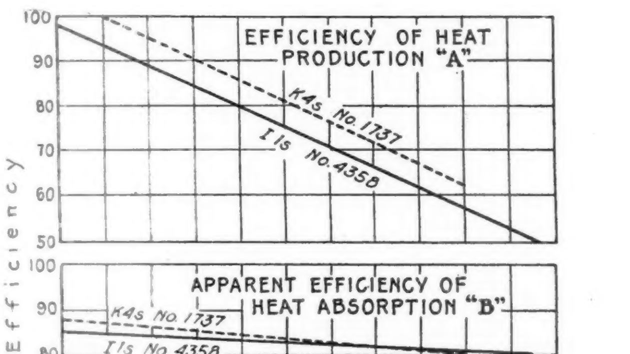
Locomotive test plants—Their influence on design*

Progress made during the past 20 years makes further advance more difficult—Exact knowledge is essential for future development

By Lawford H. Fry
Metallurgical engineer, Standard Steel Works, Burnham, Pa.

No study of locomotive development and operation can be complete without full consideration of the work done by the locomotive testing plant at Altoona, Pa., as the results of this work have materially influenced locomotive design not only in this country, but abroad. W. Rowland is designing locomotive boilers in England by methods developed largely from test data obtained at the Altoona test plant and his formula has been adopted by the Railroad Board of India as a basis for its official method of estimating locomotive boiler evaporative capacity.

It is possible on a modern testing plant to operate any given locomotive through its whole range of power. Within this range any desired combination of conditions, such as speed, cut-off, etc., can be selected and maintained constant during a run of an hour or more, and while running under such constant conditions, measurements can be made with laboratory accuracy and completeness. It is this combination of constancy of conditions and accuracy of measurements which gives the tests made on a testing plant their great advantage over road tests of locomotives. Road tests with a dynamometer car are valuable for checking and completing information obtained on the plant as to draw bar pull, but in all questions of steam production and consumption, the plant results are far more authoritative. There is much detailed information which now controls locomotive design which it would have been practically impossible to obtain without a locomotive test plant.



Locomotive-boiler efficiencies in relation to rate of firing

The locomotive testing plant is of purely American origin, and though the results of the tests made here have been much studied abroad, no real testing plant has been installed outside of the United States. The first locomotive testing plant was designed and erected at Purdue University under the supervision of Dr. W. F. M. Goss, in 1891. Locomotive testing plants have, therefore, been in use for over 33 years, that is for one-third of the century during which steam locomotives have been used in America. The growth in locomotives since the first plant was installed may be measured by the fact that the first locomotive tested at Purdue was a 4-4-0 type, a representative passenger locomotive of that date, weighing in working order about 85,000 lb., while the most recent Pacific type passenger locomotive tested on the Altoona plant had a weight of 309,000 lb., or more than three and one-half times as much.

Altogether six locomotive testing plants have been built and operated. One at Purdue built in 1891, two built by the late Robert C. Quayle of the Chicago and North Western in 1894 and 1895, and one at Columbia University in 1899. These four were all of small capacity, and with the exception of Purdue have been abandoned.

The first modern locomotive testing plant capable of handling locomotives of various designs was that of the Pennsylvania Railroad built in 1904. This was designed by the late Axel Vogt, then mechanical engineer, assisted by W. F. Kiesel, Jr., the present mechanical engineer of the Pennsylvania System. This plant was first installed at St. Louis, Mo., for the Louisiana Purchase Exposition in 1904, and after operating there throughout the exposition it was transferred to its present location at Altoona.

The latest plant is that at Illinois University built in 1914 under Dr. W. F. M. Goss when dean of the College of Engineering, and Prof. E. W. Schmidt in charge of the Department of Railway Engineering. This plant follows the general design of the plant at Altoona, but provides elaborate arrangements for catching the sparks and cinders thrown out of the stack.

The bulk of the work from the various plants comes from the Purdue and the Altoona plants. The Chicago & North Western plant was of considerable service to the early American Railway Master Mechanics Association committees on exhaust nozzles. The Illinois University plant has published two reports on tests, one describing

*Abstract of paper presented at the regional meeting of the American Society of Mechanical Engineers, Altoona, Pa., October 5 to 7, 1925.

complete tests of a consolidation locomotive, the other covering tests with six sizes of Illinois coal.

The majority of the work at Purdue has been done with the two 4-4-0 locomotives built for the plant. Of these, the earlier weighed 85,000 lb. and was replaced in 1897 by a locomotive weighing 109,000 lb. which was later superheated. With this locomotive the general characteristics of locomotive operation have been studied. The most elaborate and the latest work is given in two reports published by the Carnegie Foundation in 1907 and 1910. These cover two series of tests by Dr. Goss, studying the effect on boiler and engine operation, of variations in steam pressure and variations in superheat. The information given by these and by earlier tests is of general value to a designer endeavoring to secure a proper balance between cylinder power and boiler capacity.

The installation of the Pennsylvania Railroad locomotive test plant at the St. Louis Exposition in 1904 opened a new and important era in locomotive testing. Earlier plants had been adopted only for testing light four coupled locomotives. The Pennsylvania plant was capable of handling locomotives of much greater weight and more varied design. Immediate use was made of the greater plant capacity. The series of tests made at St. Louis covered eight locomotives of widely different designs, and the data secured and published was far more complete than any previously available. These tests were the first to furnish sufficient information to enable heat balances to be drawn up for a locomotive boiler. Such balances were computed and published by the writer in 1908, and gave for the first time exact knowledge as to the relative importance of the various losses which determine the efficiency of the locomotive boiler. Since the transfer of the plant to its present location in Altoona, much work has been done in testing new locomotive designs as produced, and in providing a constantly accumulating mass of information which has made possible continued improvements in design. The greater part of the activity of the plant in Altoona has been carried out under J. T. Wallis, now chief of motive power, Pennsylvania System. Direct charge of the test plant was in the hands of C. D. Young, engineer of tests, from November, 1911, to May, 1917, and is now in the hands of his successor, F. M. Waring.

The great influence which the work done on the Altoona plant has had on locomotive design is indicated by the following statements as to the work done and conclusions reached. These are abstracted from the Pennsylvania Railroad's test plant bulletins as shown by the reference numbers.

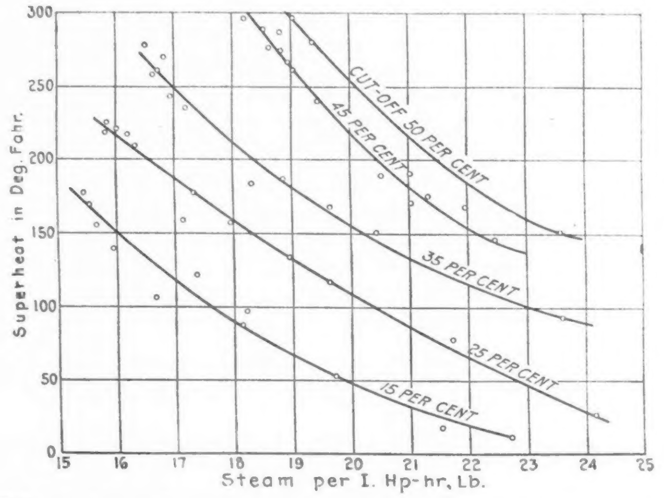
Bulletin No. 9.—A self-cleaning front end was developed which gave better results than the design recommended by the Master Mechanics Association.

Bulletin No. 21.—A comparison was made between the results obtained with long and short boiler tubes. It was established that the rate of evaporation is limited by conditions of combustion and not by a failure of heating surface to absorb heat.

Bulletin No. 23.—It was shown that a diameter of 12 in. was sufficient for piston valves for cylinders up to 27 in. in diameter, when superheated steam was used. Subsequent tests showed that valves of this diameter could be used with 30-in. cylinders with the cut-off limited to half stroke. Measurements of the stresses in the valve stems gave definite figures showing that the valve gear could be lightened to advantage by using valves of the minimum size.

Bulletin No. 24.—An extensive series of experiments on superheaters of various designs produced data showing steam consumption for varying conditions of superheat, cut-off and speed. These tests gave for the first time authentic information unobscured by other variables, as to the effect of variations in superheat on steam consumption.

Bulletin No. 27.—As a result of earlier tests on the plant, certain changes in the design of the E-6s Atlantic type locomotive were recommended. Tests of the locomotive redesigned as recommended gave a maximum evaporation 15 per cent greater, combined with a boiler efficiency nine per cent better than the original locomotive. At the same time the engine performance was generally better so that a higher drawbar pull was developed at all speeds and the maximum drawbar horsepower was increased over 20 per cent. These advantages were secured with an increase in total weight of only 2.5 per cent. Careful design of the reciprocating parts enabled them to be kept down in weight so that the dynamic augment at



Effect of superheat on steam consumption at various speeds and cut-offs

70 m.p.h. was less than 30 per cent of the static load on the drivers.

Bulletin No. 29.—Tests were made with a K-4s Pacific type locomotive built in 1914 in accordance with recommendations and experience obtained with locomotives of earlier designs on the testing plant. The coal and water rates and the high thermal efficiency showed this to be the most economical passenger locomotive so far tested on the plant. For any given amount of fuel fired, this locomotive developed more power than any previously tested at the test plant.

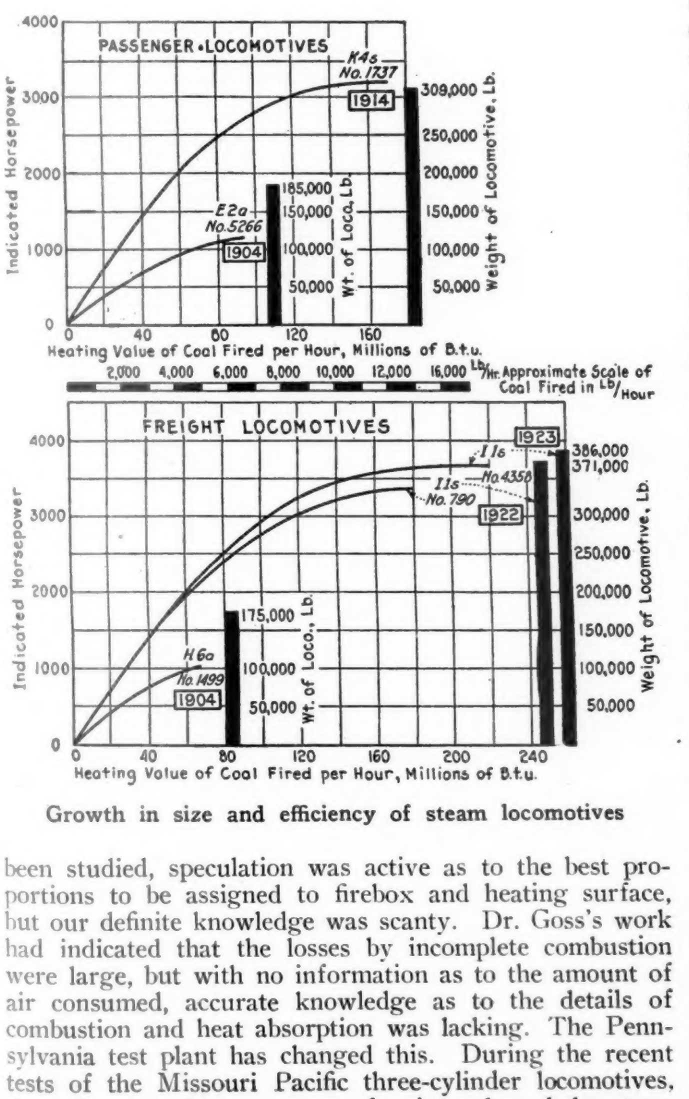
Bulletin No. 30.—Accurate tests demonstrated the advantage gained in boiler efficiency by the use of a brick arch when high volatile bituminous coal is being rapidly burned.

Bulletins No. 31 *and* 32.—The testing plant having shown definitely the great difference in steam consumption between cut-off at full stroke and cut-off at half stroke it was logical to attempt to produce a freight locomotive which, even in low speed drag service could operate at cut-offs of not over 50 per cent. The result was the development of the Ils Decapod class locomotives with a boiler pressure of 250 lb. per sq. in., instead of 205 lb. and with cylinders enlarged to enable full power to be developed without using a cut-off longer than 50 per cent of the stroke. Compared with the previous standard freight locomotive, the new locomotive with an increase of 16 per cent in weight gave an increase of 25 per cent in power, and in full gear at low speed showed a reduction of 38 per cent in steam used per indicated horsepower. This type of locomotive with feedwater heater added, giving a further increase of two per cent in indicated horsepower, is now

the standard freight locomotive of the Pennsylvania System.

One of the charts has been prepared to show the growth in the size and efficiency of the passenger locomotives of the Pennsylvania Railroad since the test plant was put into service. The E-2a Atlantic type locomotive of 1904 is compared with the K-4 Pacific type locomotive of today. The curves show the indicated horsepower in relation to the rate of firing. The heavy vertical lines represent the locomotive weights. The weight has increased from 185,000 lb. to 309,000 lb. The maximum horsepower has increased from 1,200 hp. to 3,300 hp. The increase in power has been much more rapid than the increase in weight. This can be seen from the fact that the indicated horsepower developed per 1,000 lb. of locomotive weight has increased from 6.5 hp. to 10.7 hp., that is, by 65 per cent.

So far we have described the work of the Altoona test plant by abstracts from the bulletins which deal mainly with the solution of concrete problems arising out of the testing of certain definite designs of locomotives. The test plant has, however, been of great value in providing material for a study of locomotive operation in general terms and in thus advancing our knowledge of the subject. Probably the greatest advance has been made in knowledge pertaining to the factors which determine boiler efficiency. Before the Pennsylvania test plant results had been studied, speculation was active as to the best proportions to be assigned to firebox and heating surface, but our definite knowledge was scanty. Dr. Goss's work had indicated that the losses by incomplete combustion were large, but with no information as to the amount of air consumed, accurate knowledge as to the details of combustion and heat absorption was lacking. The Pennsylvania test plant has changed this. During the recent tests of the Missouri Pacific three-cylinder locomotives, the writer was shown a curve of estimated smokebox temperatures drawn up before the tests were started. These, in the majority of cases, did not differ from the results actually obtained by more than 15 deg. F.



Growth in size and efficiency of steam locomotives

All locomotive boilers show a drop in efficiency with an increase in the rate of operation, and if the efficiency is plotted against the rate of firing it is found that the relation is best expressed by a straight line. The straight line for the boiler efficiency of the K-4s Pacific type locomotive is shown on the chart of boiler efficiencies in relation to rates of firing. The Pennsylvania test plant results if analyzed enable us to split up this overall boiler efficiency into two components—

a—Efficiency with which heat is produced.
b—Efficiency with which heat is taken up by boiler.

These component efficiencies follow closely straight line laws, as shown on the chart.

The information thus secured is important in any attempt to improve the boiler efficiency. The line for the efficiency of heat absorption shows but slight variation with the rate of firing, the values being uniformly high, ranging from 86 per cent to 80 per cent. These figures represent the heat taken up as percentage of the heat actually produced. Now the smokebox gases cannot possibly be cooled below the temperature of the water in the boiler. Therefore, not all of the heat produced is absorbable by the boiler. It can be computed that the boilers in question are taking up between 94 per cent and 88 per cent of the heat which it is physically capable of absorbing. This is characteristic of modern locomotive boilers, and it is evident that as pieces of heat interchange apparatus they are highly efficient and that there is but a small margin for improvement in heat absorption.

The efficiency of combustion shows a different condition. Here an efficiency of 100 per cent is possible and is shown by the tests to be reached at low rates of combustion. At the ordinary rates of operation, however, usual values are in the neighborhood of 60 per cent or less.

There is evidently a considerable field for improvement here, but it must not be assumed that improvement is easy. There is necessity for considerable study before the final answer is given. The diagrams show that boiler efficiency can be improved by reducing the rate of firing per sq. ft. of grate area. If the same power is to be maintained this means an increase in the size of the grate so that the total amount of coal burned may be maintained. Locomotive designs adopted by various railroads in the last few months show development along this line, but as yet no locomotive testing plant analysis of performance is available.

In this connection, the writer calls attention to the fact that in the discussion of boiler efficiency in relation to the rate of operation it is usual, as has been done above, to measure the rate of firing in terms of coal per sq. ft. of grate area per hour. This assumes that the grate area is the controlling factor in determining the efficiency of combustion. Grate area is an important factor, but not the only one. Firebox volume must also be given consideration.

The test plant data is not yet sufficiently complete to permit a determination of the relative values of grate area and firebox volume, but one series of tests with high volatile coal suggests that with this fuel the volume is the more important. The point deserves more study and it may be found that combustion efficiency can be best improved by a slight increase in grate and a considerable increase in firebox volume with appropriate arrangements for giving a long flame-way.

The question is extremely complex and can be most adequately answered by further test plant work. Doubtless this is but one of many problems by the solution of which the locomotive test plant will advance still further the development of the steam locomotive.

For the future we look with confidence to a continued

growth in the use of the locomotive testing plant. The great increase in locomotive efficiency which has taken place in the last 20 years makes further advance more difficult, and makes exact knowledge a necessary condition for such advance. As it is the function of the locomotive test plant to provide exact knowledge it is not surprising that new plants are under consideration by railroads and by locomotive builders. A great step forward could be made if the American Railway Association were to construct or to take over a locomotive test plant to be devoted to the scientific and impartial study of locomotive designs and devices and to research work concerned with the basic scientific laws governing locomotive operation. Correct locomotive design is only possible when the definite natural laws governing locomotive operation are known.

The foreman and his responsibility

Two more of the contributions which were submitted in the competition on this subject

SO much attention has been given by our readers to the articles by contributors to the *Railway Mechanical Engineer* competition on the foreman and his responsibilities and opportunities that the following contributions have been selected for publication:

A roundhouse foreman's viewpoint

By Charles Frederick Maw

Locomotive foreman, Canadian National, Grand Trunk Lines in England, Island Pond, Vt.

A prominent railroad official was recently heard to say "The roundhouse foreman is one of our main keys to success." Let us see for a moment how this works out. Railroads are carriers and must have motive power. To efficiently handle and prepare the power of the various American and Canadian railroads an army hundreds of thousands strong has to be maintained. Every roundhouse, machine shop, or main shop is a busy hive of industry with its necessary quota of charge hands, gang foremen, etc., under the supervision of the locomotive or general foreman, as the case may be.

The importance of the foreman's position is obvious. He is the one man oftentimes standing between the officers or management and the employees. On his shoulders fall the responsibility of rightly or wrongly interpreting the policies laid down. To be a foreman in every sense of the word requires certain essential qualifications without which, if the foreman holds down his job, he is merely *just getting by*.

A foreman's qualifications

1. He must be a man as well as a foreman. If he has worked up from the ranks, he is cognizant of the many little troubles which daily confront the mechanic and by a judicious word here and there, can immeasurably improve the efficiency of the staff. Firmness is necessary and rightly so, but it should be tempered with good judgment and common sense. Creating "sore heads" gets nowhere.

2. He must have a good general knowledge of all duties under his supervision. I remember some years ago, a man was promoted to roundhouse foreman because of his exceptional ability at valve setting. He proved a failure. Why? Because, while he had made a determined and praiseworthy effort to master the subject of valve setting, he had studied practically nothing else and knew little or nothing about the handling and supervising of men. The foreman must be more versatile than any other man on the railroad system. Besides being of at least average mechanical ability, he must be alert to grasp the detail of the thousand-and-one things of other than mechanical nature which come under his jurisdiction.

3. He must be an organizer. This is especially the case with the roundhouse foreman. Just as raw troops, well led, have accomplished at times almost the impossible, so the roundhouse force measures up its foreman and matters progress or retrogress accordingly. His, the eye to note, as he daily goes his rounds, the weak links in the chain. His, the mind to plan and then he, the person to enthuse his charge men, gang foremen, shop foreman, boiler foreman, etc. He should encourage good work but should also make adjustments, as the service demands, without fear or favor. He should cover the whole territory under his jurisdiction at least once every day.

4. He must be approachable and diplomatic. A great deal depends on the manner in which the foreman receives a deputation of organized labor. He must uphold the policies of his employers and at the same time be courteous with the representatives of the men. If at the time it is impossible to grant their request, he must so advise them in a diplomatic manner. Likewise, when a change of policy is brought about by his employers, he must endeavor to bring this about in the roundhouse, shops and works without antagonism or estrangement. To use an expression of an old friend of mine: "A few drops of oil are oftentimes worth many tons of sand," in cases of this nature.

The personal touch so lacking in these days of organized efficiency is a great asset to the foreman fortunate enough to possess it. In small communities, the foreman is often looked to by the men as a standard by which to set their moral gages. Fortunate indeed is he who can leave a small city or town after a few years' service as locomotive foreman with the general good will of the community and the record, *"he was a square boss."*

5. The foreman must be resourceful. Oftentimes tried in the past and daily tried again is surely the foreman's lot. He frequently lacks material and must substitute (which he seldom fails to do) something equally as good. The power must be maintained and the business moved or the road suffers. The passenger power must do the job and run to schedule or the public is heard from and it begins to use the passenger trains on another road. Passenger returns drop off. The traffic department hunts in vain for business. Dividends come not. All because the little known and generally misunderstood locomotive foreman is not doing the job. Change the scene, however, and with a live wire foreman everything is prosperity, so far as efficiency of power is possible to make it so.

Lastly, the foreman should be looking ahead. Do the

railroads give their foreman the encouragement he oftentimes deserves? Do they realize the time he puts in studying and working to improve himself that their service may be more expeditiously and efficiently handled? Surely this is one thing to which the foreman is entitled. He has to be an administrator of no mean ability to ensure success and employers should give him every encouragement and also every possible opportunity for advancement.

Must study the men

By William J. Eagan
Lehigh Valley, Sayre, Pa.

Relationship of the foreman to his men is a study which requires more than superficial examination. He is the compound which cements the man to the company in spirit as well as in practice.

He should show that he has confidence in the ability of the men under his charge to do the work assigned to them without constant watching and suggestions from him—nothing makes a force more disgruntled than the knowledge that it is being constantly watched or thought incompetent.

If a man is not properly placed he should be transferred and placed on a job that he can handle efficiently; a supervisor flagrantly displays his own incompetency by holding a man on work which he is not capable of performing efficiently.

How often do we go through a shop and see the foreman performing duties that can easily be taken care of by laborers? When the men see this going on continually, they lose confidence in the ability of the men higher up to choose leaders in the shop, and most of them have aspirations terminating, at least temporarily, in a foremanship.

A foreman should be firm without being arrogant, especially when approached by a man with a grievance. Listen to him, and if you can't adjust it at once, give him every assurance that it will receive consideration. Likewise, if he has a suggestion for an improvement in a method to increase production or for safety first, or that will better the appearance of your department, encourage the suggestion, recognizing the fact that a foreman is only as strong as is the force under him. See also that a man receives recognition from the office for such diligence. Too often the foreman has overlooked such suggestions or acted upon them as his own.

Give your time to the company unstintingly, even though there is no direct compensation from the additional effort; a foreman or man who is looking from one pay day to the next has about reached his limit, and a foreman who has that attitude will quickly relay it to his men. The company isn't a place to get a living from so much as an organization that gives a living and an opportunity to succeed.

Don't play favorites, because when they are placed upon their own feet they usually topple, and a system loaded with favorites shunts all the work upon one or two men—such an organization will fail of its own weakness. Remember, always, that an organization is only as strong as its president, and he is as strong as the assistants he picks to help him, and so on down through the whole production family to the most unskilled man. Any weak link reflects upon the man choosing or holding him.

Rock Island remodels Vanderbilt type tenders

Tank of new design applied to standard underframe—Capacity increased to 10,000 gal.—Maintenance cost reduced

THE Chicago, Rock Island & Pacific has embarked on a program of improving and rebuilding 107 Vanderbilt type tenders used in conjunction with 30 Pacific, 75 Mikado and 2 Mountain type locomotives in service on that road. The cost of conversion will be about $3,500 a tender and it is estimated that the new design will pay for itself in reduced maintenance cost within a period of slightly over four years. The original Vanderbilt tenders, purchased in 1912 and 1913, were always subject to excessive maintenance cost, owing to the fact that buffing stresses were transmitted through comparatively light plates and angles to the tanks and when the holding rivets worked or sheared off, leakage resulted and the tenders had to be taken out of service. This condition gradually became worse as the tenders got older and plates forming the lower half of the tank circle corroded and deteriorated.

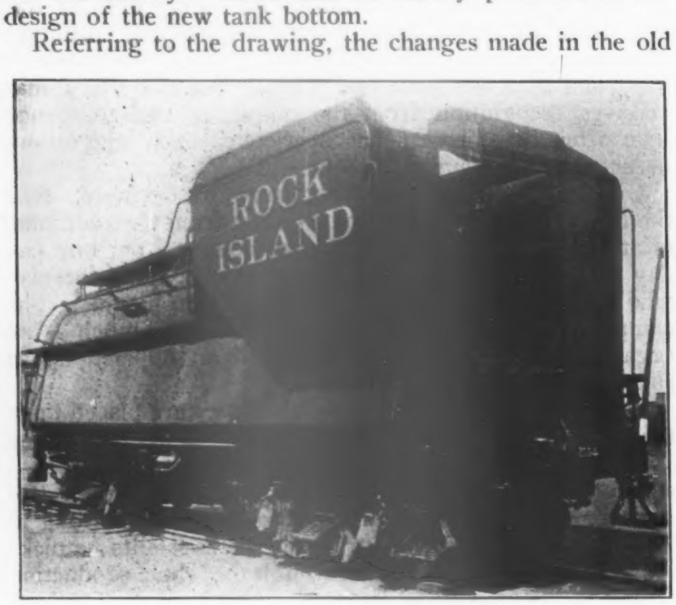
A careful individual check was kept of the expense of repairing eight Vanderbilt type tenders on the Rock Island, the figures showing an average cost of $864 every 12 to 18 months, or in fact each time the locomotive came to the shop for heavy repairs. This excessive cost, in conjunction with service delays owing to the development of leaky tanks on the road, eventually became so serious that it was evident some determined effort must be made to meet the situation. The weaknesses of the old tender design were studied and, under the direction of W. J. Tollerton, general superintendent of motive power, and George Goodwin, mechanical engineer, a new design developed which gives promise of solving the problem.

By the new design the tank of the Vanderbilt tender is completely remodeled, the lower half containing the deteriorated plates being cut away with the oxy-acetylene torch, and a new bottom substituted which is expanded to the full width of the tender at the bottom and is anchored in the customary manner to the conventional design of four-sill tender frame. The new construction is indicated in the drawing and photographs.

While some additional capacity is gained by widening the tank at the bottom a certain amount is lost through cutting off that part of the original tank cylinder which extended below the top of the present tender frame. The tank length in the new Rock Island design has been in-

creased 30 in. which gives a net added capacity of 1,000 gal., or a total capacity of 10,000 gal. It is obvious that a still further increase in capacity could be obtained by adding a suitable amount to the length of the tank and providing trucks to take care of the increased load. The coal space has not been changed. In case the tender is to be used with a stoker-fired engine, however, a trough for the conveyor screw can be readily provided in the design of the new tank bottom.

Referring to the drawing, the changes made in the old

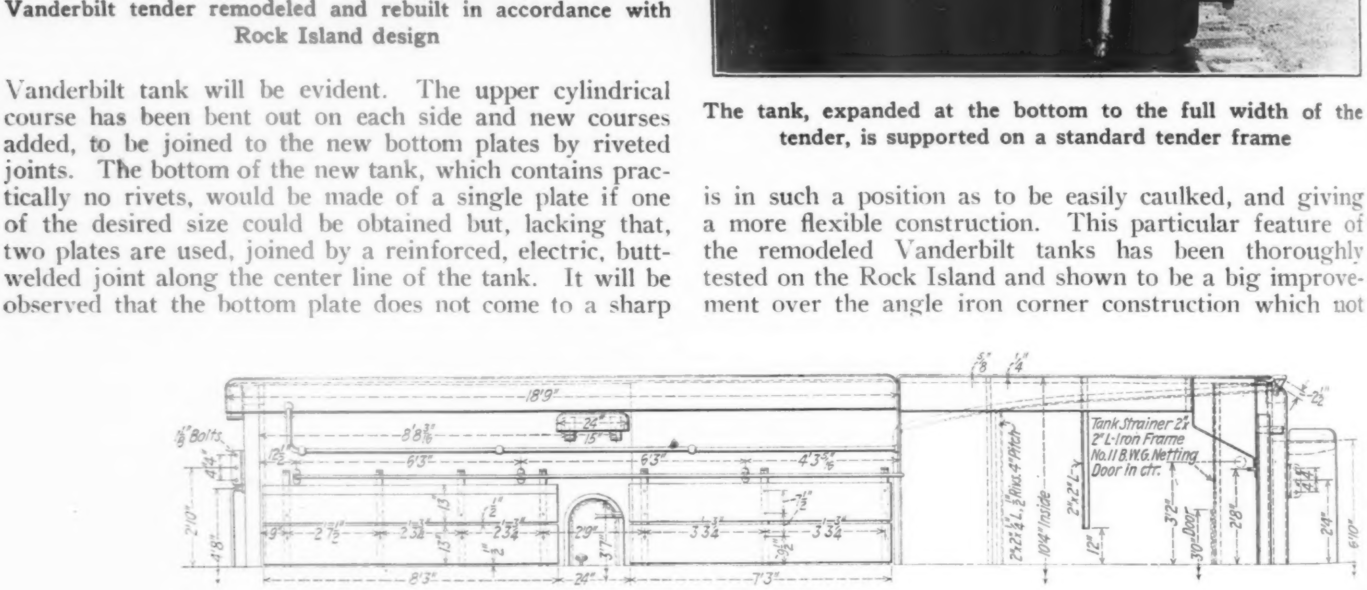


Vanderbilt tender remodeled and rebuilt in accordance with Rock Island design

Vanderbilt tank will be evident. The upper cylindrical course has been bent out on each side and new courses added, to be joined to the new bottom plates by riveted joints. The bottom of the new tank, which contains practically no rivets, would be made of a single plate if one of the desired size could be obtained but, lacking that, two plates are used, joined by a reinforced, electric, butt-welded joint along the center line of the tank. It will be observed that the bottom plate does not come to a sharp corner and join the side plate by being riveted to one flange of an angle iron as is customary with rectangular tanks. Instead, the edges of the bottom plate are bent to a 5-in. radius and riveted directly to the side plates. This eliminates one joint, leaving but a single joint which

The tank, expanded at the bottom to the full width of the tender, is supported on a standard tender frame

is in such a position as to be easily caulked, and giving a more flexible construction. This particular feature of the remodeled Vanderbilt tanks has been thoroughly tested on the Rock Island and shown to be a big improvement over the angle iron corner construction which not



New tender design developed by the Rock Island to overcome weakness inherent in its Vanderbilt tenders

only has the additional joint but offers so rigid a resistance to the weaving action of the tank under the surge of the water that something must give and as a result the plates or angle irons crack or rivets work loose.

Another feature which tends to prevent leaky corners with the new design is the provision of special, continuous, U-shaped braces to stiffen the lower half of the tank and make it retain its shape under stress. There are three of these braces, made of 5-in. by 3-in. T-iron, and by forming the sides and bottom of each brace of one continuous piece it is possible to get away from the weak construction of having side braces which terminate at the bottom corner of the tank and cause leaky rivets at that point under the weaving action of the tank. As shown in the drawing, the braces are not fitted exactly to the corners of the tank but the change in direction from the sides to the bottom is accomplished by two bands of 6-in. radius each and a short section of 45 deg. slope. The back head of the tank is new and the splash plates are fitted with new T-irons. The running boards are raised and hand rails and ladders changed to suit. The cost of remodeling the tank including the provision for an increase in capacity of 1,000 gal. is $1,600.

One of these tenders, after being out of the shop nearly two years, came in for general repairs, the entire cost of tender work being $40, most of which was caused by the application of a new pair of wheels. In other words, the maintenance on the tank itself for the first two years was negilgible. Even as the remodeled tenders get older, the cost of maintenance will unquestionably be but a small fraction of that of the old Vanderbilt type tenders. The entire conversion program wiil cost approximately $3,500 a tender, including labor, material and shop prorata, and this cost will be practically wiped out in a period of a little over four years.

Ten of the Vanderbilt tenders have been converted to date and the success of the new design has been such that it is being considered for application to new power.

A study of locomotive whistles

The whistle should be located in front and placed in a modified parabolic reflector

By Arthur L. Foley

Head of department of physics, Indiana University, Bloomington, Ind.

About five years ago the writer was employed by a railroad company to test the whistle, bell and headlight of one of the company's locomotives that had killed and injured a score of school children in a hack at a road crossing. The driver had obeyed the warning to "stop, look and listen." Apparently he had not seen or heard, although he had gotten out of the hack and walked to the center of the railroad track trying to do so. Why? I shall not try to answer this question in this specific case. It is the general case that most concerns us, for such accidents are quite common.

No doubt the crossing menace would be lessened somewhat, but it would not be removed, if by legislation or otherwise the public could be induced to stop, look and listen. Most crossing accidents involve motor cars. If the driver stops and sits in his car, his seeing may be prevented by buildings, corn fields, or other obstructions, and his hearing by motor noise, particularly in the case of the closed car. If the driver gets out of his car and walks to the center of the track and looks, he may even then, due to track curvature or adverse weather conditions, not be able to see an approaching locomotive as far away as would be necessary for safety. He may see the locomotive at a considerable distance and be deceived in thinking that he has plenty of time to cross the track before the train can reach the crossing. It should be remembered that a train running 60 miles per hour travels a third of a mile in 20 sec., the average time required for a driver to return to his car, take his seat and drive the car to the track. These facts, together with the obvious fact that nothing short of an army of police could bring about a general observance of the "STOP" part of the warning, emphasizes the importance of the "LISTEN" part of it. It is more important than the "LOOK," for the driver of a car who does not keep his eyes rather closely focused on the road he is driving over is more dangerous to traffic than is the locomotive whose path is fixed. But the driver may listen all the while, and may hear a locomotive which it would be impossible for him to see. It is timely, therefore, to consider the efficiency of locomotive whistles as danger signals, particularly since closed cars are coming into such general use. Such cars shut out a considerable fraction of the whistle sound and shut in much of that from the motor. The sound from the whistle must be sufficiently intense to be heard above, and of such a character as to be differentiated from, the hum of the car's motor and other mechanism. The locomotive whistle in common use signally fails to meet these requirements. It is rather strange that it has survived so long in this age of striving after efficiency.

Actual distribution of sound about a locomotive whistle—Ear estimates

The writer's first experiments on this question consisted in determining how far a certain locomotive whistle could be heard in various directions from the locomotive, when the listeners were in a closed automobile standing still with engine running, and again with engine stopped. Also when in a touring car under the same conditions. Ear estimates of the whistle intensity were made by each of five listeners when the automobile was stationed 1,200 ft. from the locomotive, in various directions, with the engine running and when the engine was stopped, on clear days and foggy days, and on days with various wind velocities. Finally, ear estimates were made of the relative intensities of the sound of the whistle at various distances ranging from 1,200 ft. to four miles, when the listeners were standing on the ground near an automobile with the engine running, and 20 ft. from the car with the engine running and when stopped.

The results of these and similar observations will not be given here, as they were confirmed by later quantitative experiments which will be discussed in some detail.

However, the writer has no apology to offer for mentioning such apparently crude observations. After all, it is the ear effect that the locomotive engineman must depend upon to save the lives of those crossing the railroad tracks, and the railroad company from damage suits. If the results of the ear estimates differed essentially from those made mechanically, I should discard the latter and base my conclusions on the former.

Quantitative measurement

In Fig. 1 is shown the respective radii of the 10 points (crosses) on the broken curve *A*, which indicate the relative sound intensities in the ten indicated directions from a chime whistle *W* on a locomotive *L* standing on a turntable on the track *T-T*. The intensities were measured with a Rayleigh disc. On the first day the observations were attempted a Webster phonometer was used to measure the sound intensity. On account of the extreme sensitiveness of this instrument to small changes of pitch, it was not satisfactory for the work in hand. It was, therefore, with little regret that the writer was forced to discontinue his experiments that day on the demand of some one to whom the noise of the whistle was objectionable.

Before undertaking the experiment a second time, the writer experimented on different forms of Rayleigh discs. The instrument in the form finally chosen was less sensitive than a tuned Webster phonometer, but had a much wider range through which the pitch of the sound might change without seriously affecting the instrument's sensitivity.

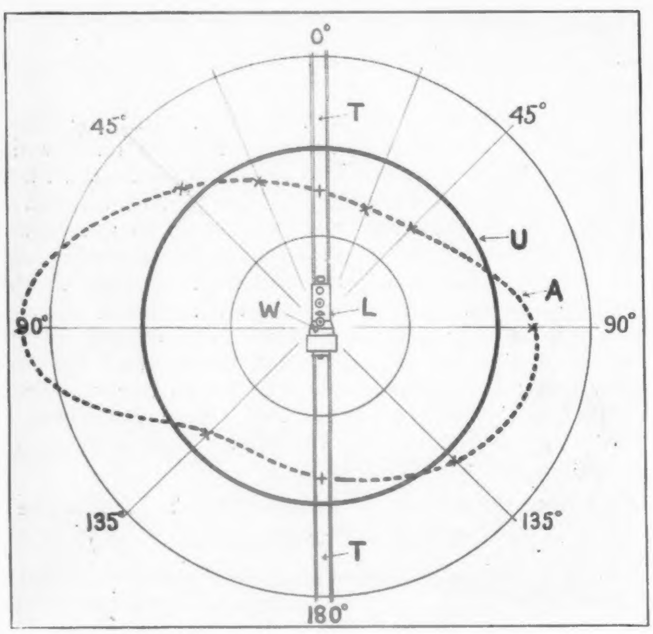


Fig. 1—Sound intensity, curve A, about a locomotive whistle mounted near the steam dome

The intensities shown in Fig. 1 were measured in the 10 directions shown, at a uniform distance of 1200 ft. from the whistle. Instead of moving the observing station the locomotive was placed on a turntable and the observing station located permanently at the side of the track 1200 ft. from the turntable. Then the locomotive was successively turned so that the relative direction of each of the 10 observing stations was that indicated by the respective numbered radii in Fig. 1.

Even had it been possible to move the Rayleigh disc and adjust it to the same sensitivity in all 10 positions, and had the time required been no consideration, the scheme of turning the locomotive had many advantages. It minimized, by making more nearly constant, the disturbing effects of winds, temperature changes and differences, the varying topography of the surrounding landscape, and reflections from houses, trees, and other objects.

The continuous curve *U* shows what the sound intensities in the several directions would have been if the sound of the whistle had been radiated uniformly in all directions. Note that the sound of the whistle, curve *A*, was actually more intense behind the locomotive than in front of it, and two or three times as intense at right angles to the track as along the track. In other words, most of the sound energy was dissipated at right angles to the track. Why this objectionable distribution?

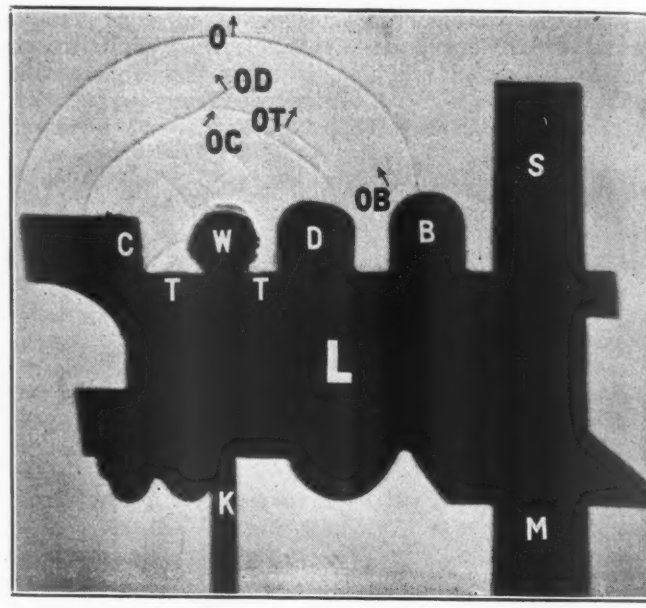


Fig. 2—Sound waves from an electric spark reflected from parts of a miniature locomotive

The general contour of curve *A* is about what one should expect from a whistle located as this one was, to the side of and rear of and only a few inches from, a steam dome several times as large as the whistle itself. Sound reflection from the steam dome and other parts of the locomotive and sound absorption by the hot gases issuing from the smoke stack and rising from the boiler explain the matter. Let us consider these effects separately.

Sound reflection

From the standpoint of sound reflection, also refraction and absorption, as we shall see later, the location of a locomotive whistle is bad, usually about as bad as if it were placed inside the cab or under the locomotive itself. It is always behind the stack, usually behind one or more domes and the bell, and frequently immediately behind or at the side of pop valves or other accessories mounted on the top of the boiler. All of us know that if we wish to shout to some one at a considerable distance that we turn toward the listener so that the sound will be projected initially in that direction. All of us know that we can be heard at a greater distance if we do not stand behind a lamp post or a tree when we shout. Nevertheless, we continue to locate whistles from the standpoint of convenience only, with no thought of a possible connection between the whistle's location and its efficiency in doing the only thing it is expected to do; namely, to make as much noise as possible in front of the locomotive

and as little as possible where it is not only not needed, but is usually a nuisance.

When the whistle is placed behind the smoke stack, dome, etc., all these objects reflect the energy of the portion of the sound wave that falls upon them. Since a sound wave has been long compared with a light wave, the sound shadows thus produced are not comparable in density or definiteness to the light shadows that would result were the whistle replaced by the headlight. Nevertheless, there are sound shadows of more or less intensity, depending on the size of the object casting them and on its distance from the sound source. In other words, depending on the solid angle of the object as seen from the sound source. Where the distance is small and the angle large, as when a whistle is mounted very near a dome or a pop valve, immediately behind or at one side in some recent practice, the intensity of the sound ahead of the locomotive is decreased and at the side or rear increased over what it would be were the whistle mounted in front of the smoke stack. This is clearly shown in curve *A* of Fig. 1, and is illustrated in Figs. 2 and 3.

If the reader's imagination is sufficiently strong, perhaps he may think of *L* in Figs. 2 and 3 as a crude miniature locomotive with exaggerated dimensions of some of

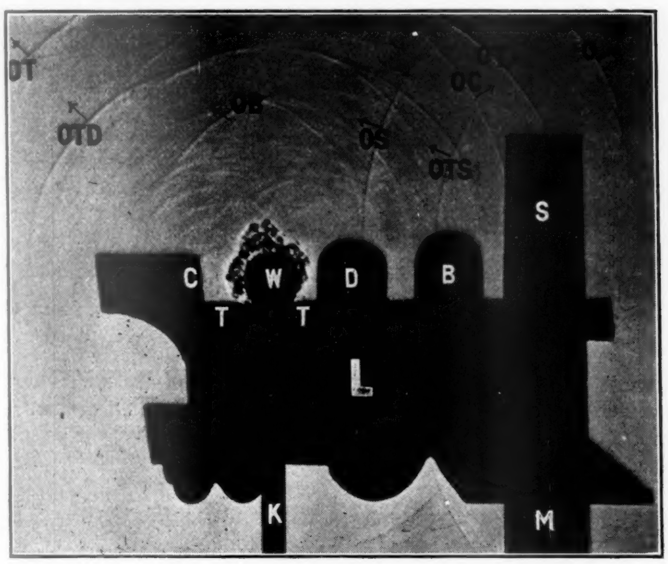


Fig. 3—Sound waves from an electric spark, showing sound waves of greater radius than those shown in the preceding figure

the parts. The smoke stack *S* was the upper end of a metal tube *M* about two feet long, which served also to support the model. *C* is the cab, *D* the steam dome, *B* the sand box and *T*-*T* the top of the boiler. The whistle *W* consisted of a spark gap behind a disc of insulating fibre, the gap being about ¾ in. long and connected through conductors *K* to an electric influence machine. The crack of the electric spark produced the sound waves shown in the figures. These waves were photographed by a method described by the author in the November, 1912 Physical Review and also in the Scientific American supplement of February 15, 1913.

In Fig. 2, *O* is the original sound wave produced by the spark at *W*. If the wave had encountered no obstructions it would have traveled outward from *W* uniformly in all directions, as in Fig. 4. We note, however, that there have been many reflections. *O B* is the reflection of *O* from *B* "caught in the very act." *O T* is the reflection of *O* from the top of the boiler *T*, *O D* from the steam dome *D* and *O C* from the cab *C*.

It is interesting to trace the further development of these waves, as shown in Fig. 3, a photograph taken about .0001 sec. later than the photograph in Fig. 2. The same lettering is used in both figures, the arrows indicating the direction of the waves. In Fig. 3 the original wave has passed out of the field on the left of the picture and shows only at *O* at the upper right hand of the photograph. *O S* is a reflection of *O* from the stack *S*. Note that *O T* in Fig. 2 has expanded, struck the stack *S*, and given us the wave *O T S* in Fig. 3. *O C* of Fig. 2 has just arrived at the stack in Fig. 3.

It is not necessary to trace all the waves that have been formed. It is sufficient that we see that, owing to numerous reflections, the space above the model locomotive is filled with waves, that most of the sound energy is headed upward, and that there is not enough in front of the locomotive to show in the picture.

Owing to the shortness of the spark waves and the exaggerated dimensions of some of the parts of the miniature locomotive, Figs. 2 and 3 exaggerate the magnitude of the effects of reflection. They do, however, quite accurately represent their nature.

Sound refraction and absorption

The very undesirable sound distribution shown in curve *A* of Fig. 1 would be much worse in the case of a locomotive running at high speed. A locomotive standing on a turntable requires very little firing to keep up the steam required to operate the whistle. There is little smoke from the stack, and what there is rises some distance before deviating much from a cylindrical form. It is very different when a locomotive is moving rapidly. When running the exhaust steam is blown through the stack to increase the draft, causing smoke and hot gases to be ejected in large volumes. These, together with the convection currents from the hot boiler, are swept back over the locomotive, forming a sort of gas, steam and smoke blanket through which the sound of the whistle must pass.

It is a well-known fact that a part of the energy of a sound wave is reflected when it falls upon a stream of hot gases; some is absorbed in the stream itself and that which gets through is dispersed. The loss due to absorption and dispersion is much greater than one might imagine. If anyone doubts this statement let him stand on one side of a bonfire and try to talk to some one on the other side. He may fail to make himself heard at all.

A striking illustration of the blanketing effect of air currents and air strata of different temperatures is observed in the variation of the intensity of the sound of the exhaust of an aeroplane engine as it passes over. Sometimes the roar of the engine is quite loud, sometimes it is weak, perhaps inaudible. The shifting air currents and the changing path that the sound must take to reach the ear from a moving plane cause the intensity variations.

The intensity of sound in the shadow of a stream of hot gases is generally much less than it would be were the gas stream replaced by a solid obstacle of the same size. This point is illustrated in Fig. 4, which is a photograph of sound waves passing through or around cylinders of hot gases and metals. *W S* is a sound wave produced by an electric spark, perpendicular to the plane of the figure, behind the disc *S*, and *W G* a wave produced by a like spark behind the disc *G*. The sparks were made to occur simultaneously by connecting the two spark gaps in series. The waves *W S* and *W G* are consequently of the same size and intensity. *C* is a metal cylinder one inch long, of the same length as each of the spark gaps. When a spark passes at the gaps *S* and *G* there is a sudden heating of the air between the terminals of the gaps, producing at each one an expanding mass of hot air of

approximately cylindrical cross section. By properly adjusting the distances between *S*, *G* and *C* and by carefully timing the illuminating spark by which the photograph was taken, the waves were photographed in the positions shown in the figure.

Inspection of Fig. 4 shows that in passing the solid cylinder *C*, the portion of the wave *W G* which struck the cylinder was reflected to *W C*. The portion passing just above and just below the cylinder was being diffracted into the region *R* in the general direction shown by the arrows *D, D*. The solid cylinder did not, therefore, cast a definite sound shadow, though the sound intensity in *R*, the sound shadow region, was less than it would have been if *C* had not reflected some of the sound energy.

Note the difference in the region *A*, which is the sound shadow region behind the hot gases produced by the electric spark at *S*. Apparently all of the sound energy that entered the hot air cylinder near its central and therefore thicker and hotter parts was absorbed. Only those parts of the wave entering the upper and lower edges of the cylinder where the gas was not so hot and the distance to be traversed not so great was transmitted. Owing to the fact that the velocity of sound increases with the temperature these transmitted portions of the wave were refracted in the direction of the arrows *T-T*, the edges of the hot air cylinder thus functioning like a dispersing lens. Consequently the intensity of sound in region *A* was less than in region *R*, the hot air cylinder casting a deeper sound shadow than a solid body of the same size. It appears, therefore, that the disturbing effect of the high smoke stack of Figs. 2 and 3 would have

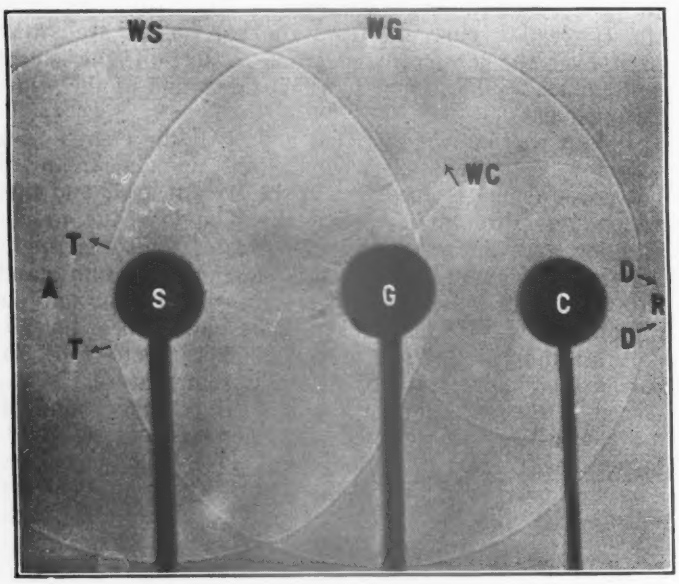


Fig. 4—Sound waves due to simultaneous electric sparks at G and S, showing diffraction about a solid cylinder C, and dispersion of the hot gas cylinder at S

been even greater had the stack been low, with hot gases issuing from it. And had the gases been blown back over the locomotive, the effect would have been even more disturbing.

A suggestion of the magnitude of the effect may be gained by comparing Fig. 3 with Fig. 5. In the latter a small bunsen burner was so placed that the tip of the flame was in the lower end of a brass tube, the upper end of which formed the smoke stack *S* of the miniature locomotive *L*. The hot gases issuing from the stack were blown back over the locomotive by means of an air jet in the direction of the arrow *A*. Observe that the original sound wave *O* is about the only one that shows in Fig. 5 and this only over the rear half of the locomotive. There is no trace of a wave near the stack, where the gases are hottest. The wave has not been hidden by smoke. What one sees in the picture is not the photograph of smoke at all. The air inlet on the gas burner had been adjusted so that the gas burned with a smokeless flame. One does not see smoke when he sees the heat, really the convection currents, rising from the hot radiator of his automobile. However, hot gases may be quite transparent to light and not transmit sound.

If the disturbing effect of hot gases and heat currents

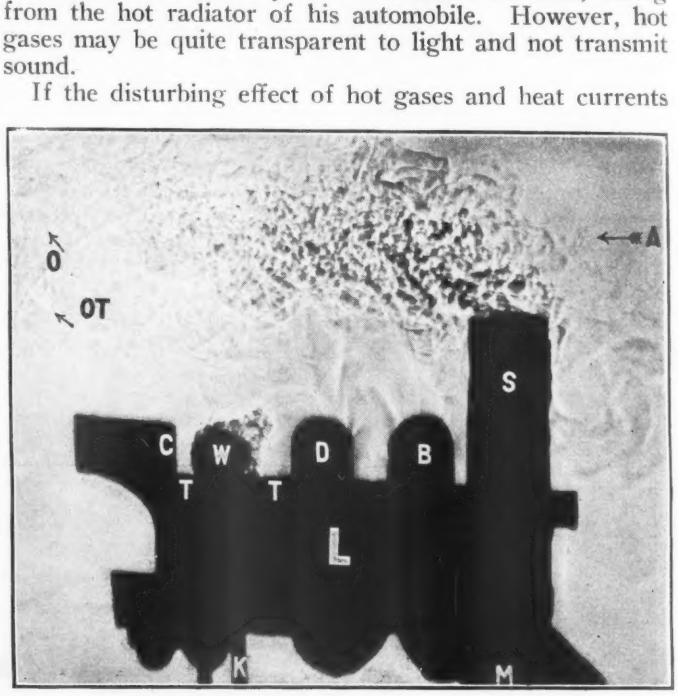


Fig. 5—Absorption of sound energy by the hot gases from the smoke stack of a miniature locomotive

were the only reason for locating a locomotive whistle ahead of the smoke stack it would be a sufficient one. It is noted that the sound was weaker both in front of and to the rear of the locomotive than it would have been had the sound distribution been uniform, while at right angles to the track, particularly on the left side of the locomotive, the intensity was much greater than with uniform distribution.

Another factor which had to do with the sound distribution shown in Fig. 6, is the design of the whistle itself. The usual cylindrical tube forming the resonator (bell) of a single tone whistle is, in the case of the chime whistle used in this study, divided by longitudinal radial vanes into five compartments or pipes, each of the proper length to give one of the notes of the chime; namely, *C, E, G, C'* and *C"*. *T* in Fig. 6 is a transverse section of the whistle and *L* a longitudinal section, with the omission of the valve mechanism at *V*. The former shows the relative positions and cross sectional areas of the five pipes while the longitudinal section shows the relative lengths of two of the pipes *C* and its octave *C'*. The fraction of the cylindrical steam jet *J* used in blowing each of the pipes is shown in the transverse section *T*, and was 26 per cent in the case of the lower tone *C* and respectively 22, 19, 17, and 16 per cent for the other four tones. Thus 60 per cent more energy was used in blowing the lower tone than in blowing the upper tone of this whistle.

Since the quality or character of a sound depends on the relative intensity of the several tones which combine to form it, it is evident that the quality of the sound from a chime whistle depends to a degree upon which pipe of the whistle is toward the observer. This variation with direction is accentuated when the whistle is

placed near a steam dome, which interferes more or less with the normal functioning of that part of the whistle which happens to be nearest it. Inasmuch as the Rayleigh disc was not equally sensitive to all five tones of the chime, intensity measurements made with the disc showed considerable variation whenever there was a change in the orientation of the whistle with respect to the dome.

The writer would locate a locomotive whistle in front of the locomotive where it would be free from the several disturbing factors named. He would place it in a reflector of such design as to give a maximum of sound intensity ahead of the locomotive and of such size as to serve as a resonator and thus increase the intensity of the sound at the source.

In advocating the use of a reflector to direct the sound of the whistle along the track the writer has continually met with the argument that such a device would be practically useless on account of the fact that the reflector could not be made large compared to the length of the sound waves to be reflected. This limitation does, of course, affect profoundly the rate at which sound wave energy spreads out after the waves are outside the reflector. But it does not change the action of the reflector itself. The energy of the reflected portion of the sound wave can be headed in the right direction, and much of it will continue in the right direction to reinforce the wave originally projected in that direction. In proof of this assertion it is sufficient to call attention to the effectiveness of a megaphone as a sound director. We should expect a relatively greater directive action from a reflector placed about a whistle. In the case of the voice the waves are originally projected in one hemisphere only, the whistle starts them in both hemispheres. The whistle reflector reflects a portion of the waves in the one hemisphere, as does the megaphone; but in addition it turns back those that start in the other hemisphere.

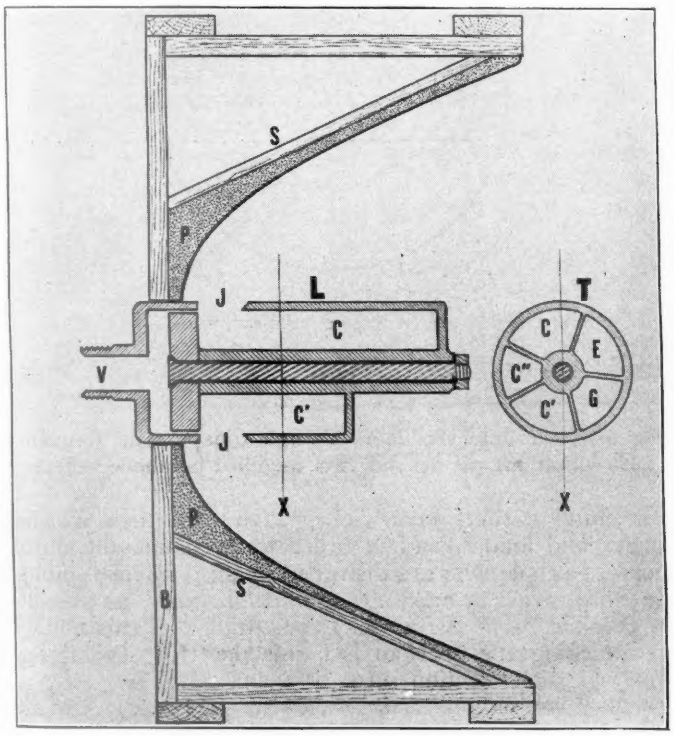


Fig. 6—Transverse and longitudinal sections of a chime whistle modified parabolic reflector

It is strange that the belief that sound can not be reflected by anything except a very large body is so persistent and so general. A person who voices this belief is quite inconsistent when he places his hand to his ear in order to hear a speaker not easily understood with the unaided ear. Even a mule knows that sound can be reflected. He turns his ears in the direction from which the sound comes. It must be admitted that the ears are not as small as they might be, but they are not as long as the sound waves the mule must interpret.

To determine whether or not a reflector of moderate size could be made to exert any considerable directive force on the sound from a locomotive whistle, the chime whistle previously described in this paper was placed in a parabolic reflector, as shown in cross section in Fig. 6 in which all dimensions are to the same scale. The whistle was 6.5 in. in diameter and the aperture of the reflector 28 in. The reflector was made of plaster paris *P* cast in a wooden box *B*. Wooden strips *S* were nailed in the box in the manner indicated in the drawing to economize on plaster and lessen the weight. The box was mounted on castors so that it could be turned on a platform about six feet in diameter and eight feet high. The steam line projected vertically through a hole in the center of the platform and was connected with a union joint to the valve end *V* of the whistle. This permitted the reflector and whistle to be rotated so that their common axis was in any desired horizontal direction.

The shape of the plaster paris surface of the reflector was obtained as follows: with a focal point on one edge of a board and the edge, the axis of a parabola, a curve was drawn on the board and the half parabola sawed out. With the board radial and its straight edge held against the whistle the board was moved around the whistle and the soft plaster paris "wiped" into position. The focus of such a reflector, if the term focus is permissible, is therefore a circle, and not a point. The focus of any particular portion of the parabolic surface is the nearest point on the focal circle. This focal circle was intended to be coincident with the cylindrical sound source—the cylindrical steam jet, at *J-J*. The length of the steam jet, the distance from the opening to the lip, was two inches. There is a question as to what portion of the jet should be used, or whether some point beyond the lip should be used, as a focal point in adjusting the whistle in the reflector. Experiments were made with the whistle in one position only, quite likely not the position to give the reflector the highest possible efficiency. Nevertheless, the action of the reflector was quite marked.

The curve in Fig. 7 gives the relative intensity of the sound in the 12 directions indicated by the radial lines. The dissymmetry of the curve with respect to the axis in direction one is doubtless due to the fact shown in the figure that the whistle was so placed in the reflector that the lower pitched and louder tone was produced on the side of the axis toward direction two, while the higher and less intense tone was produced on the other side of the axis, in direction 12. Notwithstanding the dissymmetry the curve clearly shows a sound intensity in the direction of the axis of the reflector double that at right angles to the axis and three times that to the rear.

Comparing the result shown in Fig. 7 with that shown in Fig. 1, it is seen that, by placing a locomotive whistle in a reflector in front of the smoke stack the intensity of sound along the track in front of the locomotive was increased to four times its value when the same whistle was located in the position *W* shown in Fig. 1. In direction two the intensity was five times as great. At the same time the intensity at right angles to the locomotive was correspondingly decreased. The maximum intensity could have been changed from direction two to one by rotating the whistle in the reflector.

No doubt the multiplying factor could have been fur-

ther increased had the reflector been made of a material having a higher sound reflection co-efficient that plaster paris.

The placing of a locomotive whistle inside a reflector with its longitudinal axis parallel to the axis of the reflector has advantages other than those already noted. One is, that all parts of the circular steam jet function, which is not the case when the whistle is mounted vertically and the locomotive is running at high speed. This point was investigated by placing a locomotive chime whistle in the usual vertical positon in a horizontal stream of air from a compressor capable of delivering 4,000 cu-ft. of air per minute at a pressure of 100 lb. to the square inch. The stream of air was adjusted to give air velocities at the whistle of 20, 40, and 60 m. p. h. Very little effect was noticed at 20 m.p.h. At 40 m.p.h. the front portion of the whistle, the part against which the air current was directed, functioned rather poorly, the volume of the sound being considerably less than at 20 m.p.h. At 60 m.p.h. it did not function at all, nothing but the hissing sound of escaping steam coming from this portion of the whistle. As the whistle was rotated the character or quality of the sound changed noticeably as one after another of the several tones of the chime was silenced. The steam jet whose vibrations about the lip of the whistle produce the sound, must strike that lip in a particular way to give the best result. When a locomotive is running at high speed the head on pressure and the air currents about the sides of the whistle deflect the steam jet

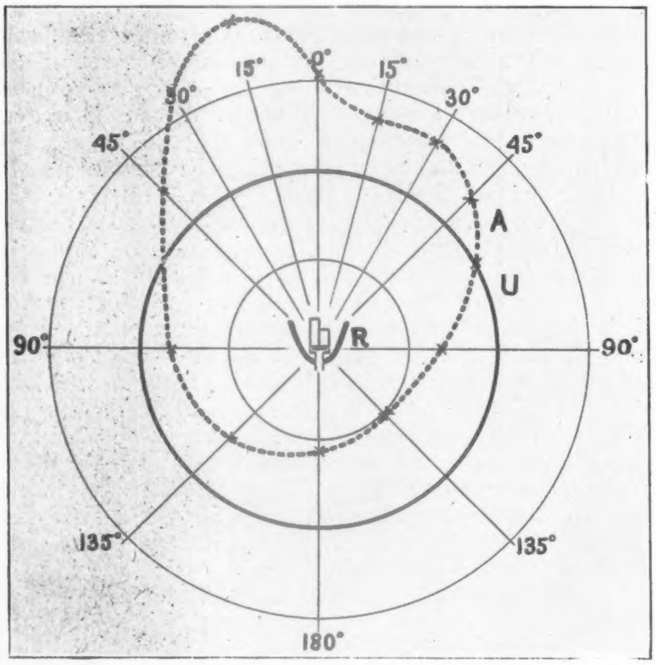


Fig. 7—Sound intensity about a chime whistle mounted in a modified parabolic reflector

so that some portions of it function poorly and others not at all.

The writer remembers a case in court in which a railroad company was being sued for damages because of a crossing accident. Some of the witnesses testified that the engineer sounded the whistle for the crossing and that "it fairly screeched." A "screeching" sound is what one would expect from a vertically mounted chime whistle on a locomotive traveling at a high speed. Let us remember that a wind having a velocity of 60 m.p.h. is normally classed as a tornado. The whistle may fail to function properly at much lower locomotive velocities if the train is running against a head wind. Thus the whistle is least efficient when the train is running fastest and the warning signal is most needed.

In the case of a whistle mounted in a reflector, as in Fig. 6, the body of air about it is carried along with it and the air pressure remains uniform on all sides of the steam jet, regardless of engine speeds or wind velocities. This permits the whistle to function normally at all speeds.

It would seem that locomotive manufacturers have attacked the problem of the inefficiency of locomotive whistles from one standpoint only—that of the intensity of

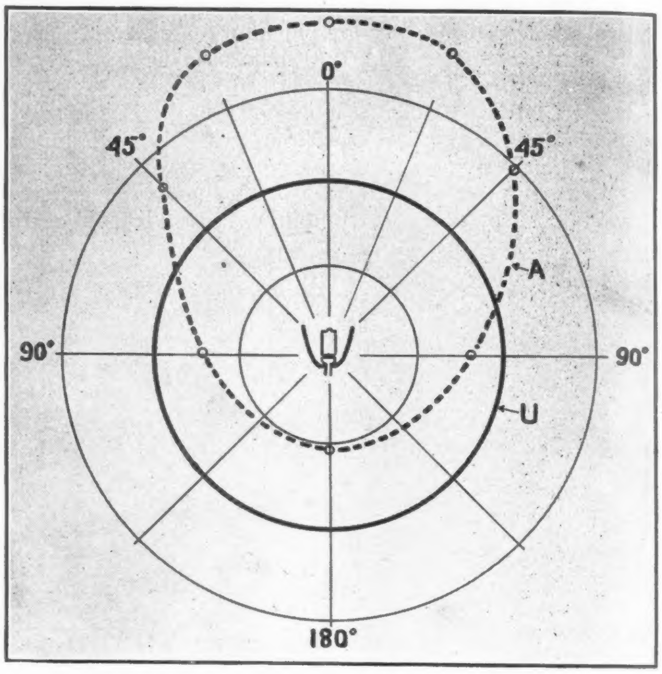


Fig. 8—Sound intensity about a single tone whistle, frequency 1,000 vibrations per second, in a modified parabolic reflector

the sound at the source. They have made their whistles larger and louder, and in order to overcome the objections of people who are disturbed by such intense sounds, they have tried to make the sounds "mellow," as pleasing as possible. It is the writer's contention that this method of attacking the problem is a mistake—for several reasons. I shall mention three of them.

First, we should consider the efficiency of the sound as a warning signal a quarter of a mile, a half mile, in front of the locomotive. We should consider the one to be warned, and not merely the sound source. If the effort to make the sound of the whistle "mellow" and pleasing results in a less efficient signal and consequently in greater destruction of life and property, it is a mistake.

In the second place the increase in the sound intensity of locomotive whistles has necessitated an increase in their size and a consequent lowering of their pitch, a move in the wrong direction. All the information that the writer has been able to get from several psychologists and from his own experiments is to the effect that the human ear is more sensitive to sounds of from 1000 to 1200 vibrations per second than to those of lower frequency. The pitch of the usual locomotive whistle is from one to two octaves too low for efficient signaling.

Another advantage of the higher over the lower pitch is that the former is much more likely to attract attention on account of the sound being unlike the hum of automobile engines and gears, and other usual sounds.

In the third place it would seem that the cost of whistle blowing is an item that has been given little attention.

We have increased the size of whistles with little or no regard to the resulting increase in their operating cost. If this increase had brought about greater whistle efficiency, it would be justified. The expected result has not been realized. A little consideration will convince one that we "pay dearly for the whistle."

According to the company that manufactured it, the chime whistle used in this investigation—a regular locomotive whistle—requires about 8,352 lb. of steam per hour when blown at 200 lb. steam pressure. Locomotive manufacturers say that seven pounds of steam per pound of coal is good average locomotive practice. This means a coal consumption of 1,190 lb. of coal per hour, more than 19 lb. per minute, approximately one pound of coal for every three seconds, or two pounds for every time the whistle is blown—the series of blasts for any signal aggregating, on the average, about six seconds.

The writer by means of a counter and stop watch made several estimates of the time whistles are blown. Observations were made on six different trains on four different roads, in Indiana and Illinois, the trips ranging from 50 to 220 miles in length. Considerable variation was found for different engine crews and for different roads. The average ran something over two minutes per hour. Assuming this figure, a locomotive equipped with the whistle described and operated at the indicated pressure requires some 39 lb. of coal and 275 lb. of water per hour for whistling purposes only.

There are in use on a 24 hour day basis, some 66,000 locomotives, and on the average one-third of these are in continuous use. To blow these whistles on an average of two minutes per hour would require the enormous total of almost 4,000,000 tons of coal and more than 26,000,000 tons of water per year. Why incur this enormous expense if a small high pitch whistle is more efficient and at the same time more economical in operation?

Curve *A* of Fig. 8 represents the sound distribution about a small whistle of the pitch recommended—frequency 1000 vibrations per second. This whistle was mounted in a tin reflector, the relative dimensions of the two being about those shown in the figure. For testing the resonance of the reflector its depth was changed three times by soldering an additional strip of tin an inch wide around the edge. Sound intensity observations were made with each depth. The resonance effect, while appreciable, was not great. It was sufficiently large, however, to warrant taking it into consideration in designing a locomotive whistle sound reflector. It will be observed that the total area of curve *A*, which is proportional to the total sound emission when the whistle was in a reflector, is greater than that of curve *U*, the emission when the whistle was vertical and without the reflector. The effect of the reflector, therefore, is not only to modify the distribution of the sound but to increase its intensity at the source.

The steam required to blow the high pitch whistle whose sound intensity curve is shown in Fig. 8 was 2,500 lb. per hour as against 8,352 lb. for the chime whistle of Fig. 1. This means a saving of 70 per cent of the coal required for whistling purposes, which on the basis of our previous estimate, would amount to some 2,800,000 tons in the United States alone. This is worth considering, not merely from the standpoint of a railroad expense item, but from the standpoint of fuel conservation.

A question that has been raised in connection with whistles of high pitch concerns the carrying power of high pitch sounds. This question is important when considering marine fog signals and steamship whistles, but of little import when designing locomotive whistles. The distance through which the sound of a locomotive whistle must pass is so limited that the difference in the atmospheric absorption of the lower and higher pitched tones may be ignored.

Whistles of the higher pitch are used almost exclusively on the locomotives of England and other foreign countries.

An objection that has been urged against the use of a reflector on a locomotive whistle is that the whistle could not be used to signal to the rear of the train—to recall a flagman, for instance. This objection is not serious. Note, Fig. 8, that the sound intensity in the rear of a locomotive is a little more than half of what it would be if the whistle were vertical and without a reflector. It should be more than sufficient to signal the flagman. It should be remembered that the flagman is listening for the whistle; he is not in a closed car, nor is he disturbed by automobile or other noises.

If it were desirable to increase still further the per cent of sound energy reflected in a forward direction it could be done without destroying the resonance of the reflector by approximately doubling its length. If then the sound in the rear proved to be insufficient for signaling purposes, a second whistle could be mounted so as to face the rear, just as two headlights are sometimes used.

It is a matter of common observation that locomotive whistles on different roads, and frequently on the same road, differ greatly in pitch and in quality. When one hears a whistle, frequently he cannot tell whether it is a locomotive whistle or a factory whistle. He becomes so accustomed to hearing such sounds, that they may call forth no mental reaction whatever. If all locomotive and traction car whistles were of one pitch and others were prohibited from using whistles of that or near that pitch, the human ear would soon come to recognize that tone and instinctively associate it with danger. Not only this, but the volume of sound required to produce a mental stimulus would be greatly lessened.

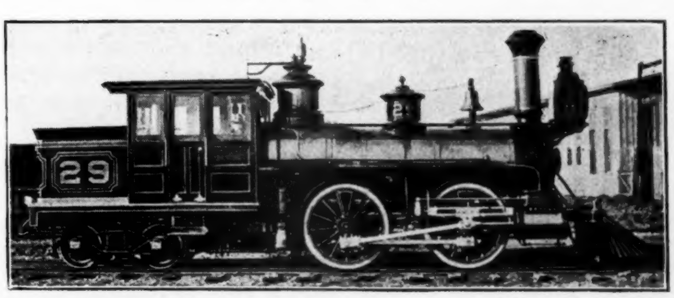
The writer advocates a legal standard pitch for all locomotives and traction car whistles, and legislation that will guarantee railway companies its exclusive use.

Conclusions

Stated very briefly the writer's conclusions are as follows:

1. Locomotive whistles, like the headlights, should be located in front.
2. They should be placed longitudinally in modified parabolic reflectors.
3. The dimensions of the reflectors should be such as to make them resonant.
4. The whistles should be of a frequency of about one thousand vibrations per second.
5. All railway whistles should be of the same pitch, no others being permitted to use a whistle within a half octave of the railway standard.

The writer wishes to acknowledge his indebtedness to H. R. Kurrie, president; J. T. Strubel, master mechanic, and Joe Little, Bloomington yard foreman, Chicago, Indianapolis & Louisville, for their interest in this study and for the railroad equipment placed at his disposal.



An old time tank locomotive of the seventies

Development of foremen

"FROM the comments of 90 separate companies that have had experience in foreman training, 83 express favorable results in no uncertain terms, five express doubtful value and most of these give what they consider to be the reasons therefor, while only two report no success whatever." This statement occurs in the preface of a study on "Foremanship—Fundamentals in the Development of Industrial Foremen"* which is the first of an "Industrial Relations Series" of studies which is being prepared by the Department of Manufacture of the Chamber of Commerce of the United States. Later there appears in the report the significant statement that, "Experience has proven that where the management supported foreman training half-heartedly, even the best methods have failed."

Recent months have witnessed a great demand on the part of railroad officers and foremen for exact information as to just how best to promote foreman training. This survey goes into the entire subject in considerable detail and will be found equally valuable for either the industrial or railroad field, since it deals with methods and practices, rather than details of the contents of the training courses. Some idea of the scope of the report may be gathered from the chapter headings which follow: Word "Foreman" Defined; Purpose of Foreman Training; Beginning Foreman Training; Sources of Instruction; Who Should Direct the Cource; Content of Course; Methods of Instruction; When Should Meetings Be Held; Where Should Course Be Held; Personnel of the Group; Number, Frequency and Length of Meetings; Follow-up; What Does Foreman Training Cost; Sub-Foremen to Foremen; and, What Some Companies Say About Foreman Training. An appendix contains the addresses of state universities which offer foreman training extension courses, as well as the addresses of state departments of education or vocational education, which provide for foreman training under the Smith-Hughes Act.

In the chapter or section on "Beginning Foreman Training," the suggestion is made that some prefer to use such terms as foremanship, foreman conferences or foreman development, rather than foreman training, "on account of the psychological effect of the word training on mature people." This suggestion is well taken in the railway field, because while it is imperative that workers be adequately trained and prepared for promotion to the position of foreman, those who now hold such positions frankly admit the need for help and guidance; indeed, they have in most cases initiated the movement toward that end and have of their own accord organized what is commonly designated as foremen clubs or associations. This chapter includes also rather complete information as to how a large company—the Westinghouse Electric & Manufacturing Company—and a medium sized one—the Corning Glass Works—started their plans for the foremen's development.

In discussing sources of instruction attention is given to sources within the organization and also Y. M. C. A.'s, private educational institutions, federal and state vocational departments, state university extension courses, and other organizations, such as manufacturers' associations, chambers of commerce, etc.

It is important to keep in mind that completion of a course of study in foremanship is little more than the beginning or scratching of the surface. To be really effective, these courses must be followed up in such a way that the foreman will be inspired to keep in touch with the latest developments and to continue his reading and studies along the right lines. Unfortunately the necessity and importance of following up foremanship courses has been recognized to only a very slight extent. One of the most important sections of the Chamber of Commerce report is concerned with a discussion of plans for following up intensive courses or conferences on foremanship. In some cases foreman's clubs or associations are formed and the report gives a typical constitution for such an organization, together with a list of 124 typical topics for papers and discussion at foreman training meetings.

The compiler of this report is indeed to be congratulated for bringing together in so small a compass so much practical and useful information, which is being eagerly sought at this time, not alone by the industries, but by the railroads and public utility organizations of this country as well.

* Copies of this 48-page, 6-in. by 9-in. pamphlet may be obtained from E. W. McCullough, manager, Department of Manufacture, Chamber of Commerce of the United States of America, Washington, D. C. Initial copies will be supplied without charge, but a charge of 10 cents each—the bare cost—will be made for additional copies.

A suggestion for firing locomotives *

By R. W. Karns

Engineer, Cincinnati Division, Pennsylvania, Columbus, Ohio

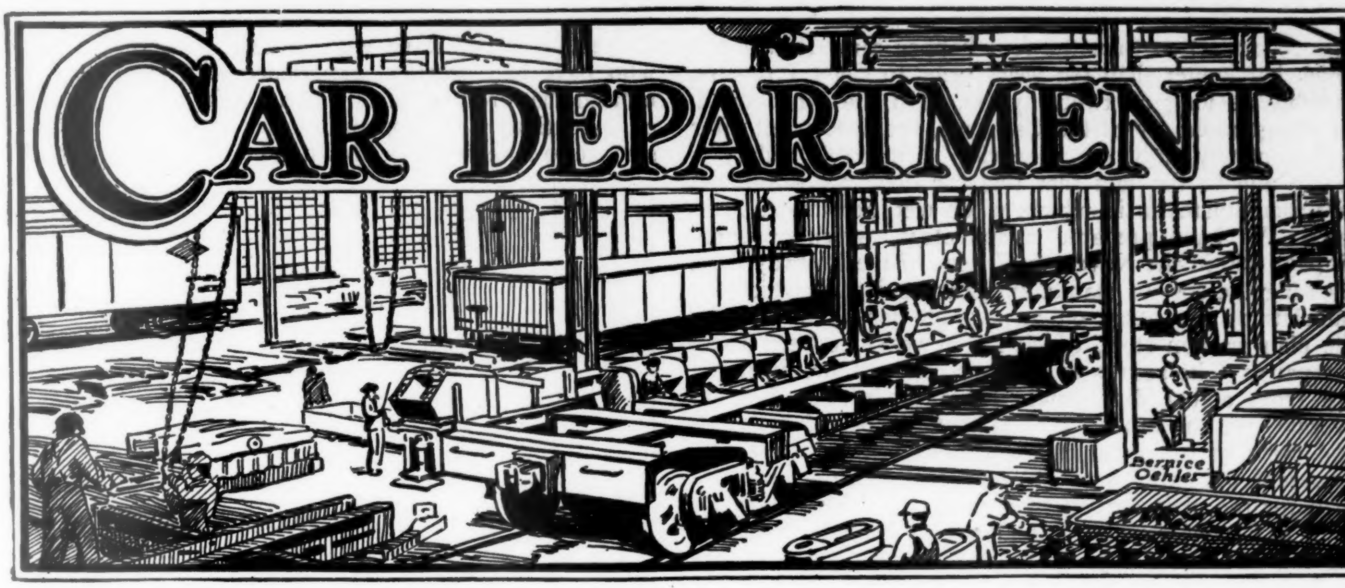
THE proper and what I think the most economical method of firing a locomotive has just been recently demonstrated to us. This system calls for a bank around the door and in both back corners of the firebox, extending forward about 15 or 18 inches. The fire beyond this bank is level and thin. As it requires more pounds of air than coal to manufacture steam, this method permits air in sufficient quantities to pass through the fire, insuring perfect combustion or as nearly perfect as can be had on a locomotive. The engine being drafted so that by maintaining this bank at the door, throwing very little ahead, using three and four shovels of coal at a fire, the draft, so to speak, will pull it ahead as it is needed. This practice lessens the work of the fireman.

This system, in addition to eliminating most of the smoke, insures a uniform steam pressure, and when a uniform steam pressure is maintained the engine can be worked to a greater advantage, the injectors can be better regulated, the superheater will better perform the service for which it is intended, which all means less coal. Care should be exercised at all times to prevent the safety valve raising as this is very wasteful and indicates that the fireman is not watching the steam gage.

In carrying out this system on our run, which is a six to eight car train in one direction and 10 to 12 cars in the other, we are actually doing the job on one-third less coal than the old system and find it much easier for the crew.

The saving of fuel is a big question and simply means co-operation on the part of all concerned. The engineer and fireman must see their work as a partnership affair, work together, keep the question of fuel before them at all times. This is our duty and when we get this spirit into our work, we will have cleaner and more pleasant runs, the service will be better, with less complaint and, most of all, the fuel consumption will be cut considerably.

*Abstract of the prize winning paper on fuel economy submitted in a contest open to engineers and firemen on the Western region of the Pennsylvania.



Rustproofing of steel materials*

Copper bearing sheet steel for cars resists corrosion—Methods of and economies effected by baking paint on passenger and freight cars—Painting with lacquer

By Dr. M. E. McDonnell
Chief chemist, Pennsylvania System, Altoona, Pa.

ENGINEERS now know that commercial steel on the market varies greatly in its tendency to rust. We have made many tests for the purpose of developing resistance to corrosion. On August 1, 1912, 15 weighed commercial steel sheets were exposed to the weather and on February 13, 1913, after six and one-half months exposure, they were wire brushed and re-weighed. It was found that the rate of rusting varied much, the minimum loss being 30.12 grains and the maximum loss 84 grains on the two sides of a square foot of surface. The results are shown in the curve in one of the illustrations and it is to be especially noted that the sheets showing the lowest losses in weight, contained copper. The curve on the plot shows the copper content. This heretofore unpublished chart was prepared in 1915, and it was largely instrumental in bringing about the decision of the Pennsylvania management to adopt copper bearing steel for car roofs.

Additional tests were made of a lot of 258, 16-gage and 230, 22-gage sheets of plain carbon and copper bearing steel which were placed in test racks and exposed to the elements. After 16 months of exposure 30, 22-gage plain carbon sheets failed while no copper bearing sheets failed. After 28 months exposure, the number of 22-gage plain carbon failures had increased to 77 during the same period only six 22-gage copper bearing sheets had failed. Some of the panels had entirely turned to rust. After 75 months exposure every plain carbon steel sheet had failed, while 13 copper bearing 22-gage sheets were free from holes or ragged edges. Also, at the end of that period, 102 of the 126, 16-gage plain carbon steel sheets had failed, while there was not a single failure among the 132, 16-gage copper bearing steel sheets. The average life of the copper bearing 22-gage sheets on this test was over 49 months, while the average life of the 84 plain carbon steel sheets was 23 months.

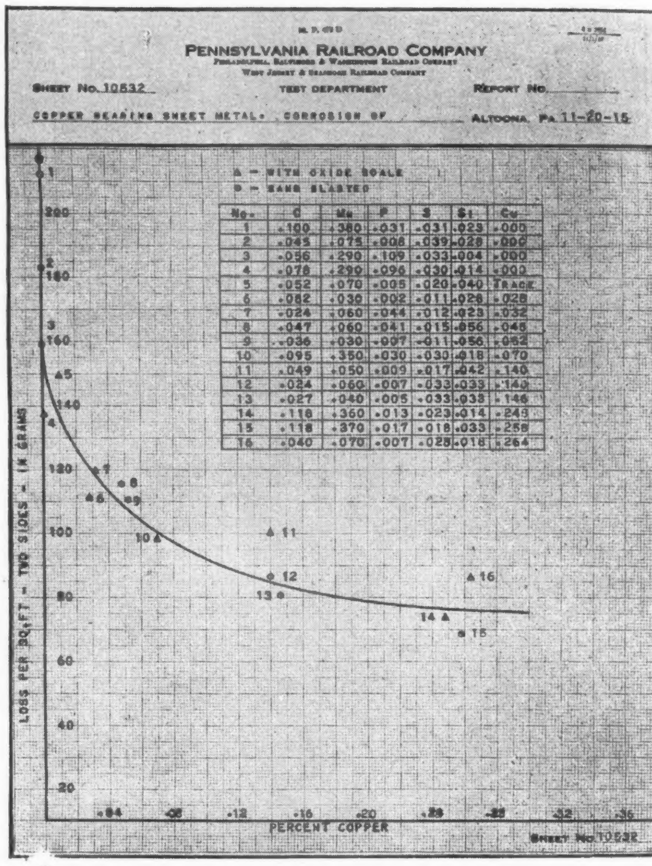
The Pennsylvania System has some 269,000 freight cars, of which 266,588 are of steel construction, 167,398 of these being steel throughout. These steel cars are of different weight and design. There are approximately 32,000 all steel box cars, on which the rate of depreciation due to rust is not yet definitely known. They can be protected against rust by means of paint coatings to a much greater extent than an open car which is used for rough freight, and the roof protects the inner side of the plates. No attempt will therefore be made to estimate the value of copper bearing steel for this class of cars.

There are 135,523 open all-steel freight cars on which much maintenance data is available. After they have been in service for a number of years, the sheets become thin and holes develop. When they have reached this condition, it is possible to patch the failed sheets, but if this is done, the surrounding sheets are likely to fail and the cost of this kind of maintenance is likely to become excessive. When failure of sheets begins to occur due to rust, it is better to apply Class 1 repairs, which involves cutting all rivets, removing sheets, and rebuilding the car body. The age of the car at which this class of repairs is called for varies some, depending on design and service. The standard four-hopper coal car designated H21a now required this attention after ten years of service. The two-hopper coal cars of the G1 type is of slightly more

*Abstract of paper presented before the regional meeting of the American Society of Mechanical Engineers, held at Altoona, Pa., October 5, 6 and 7, 1925.

rigid construction than the four-hopper car. It will run somewhat longer than ten years prior to Class 1 repairs, possibly as long as twelve years. On the other hand, on the gondola car of the Gsd type, the sheets fail after approximately eight years' service. This rapid failure is partly due to the fact that this car does not drain and dirt accumulates in it, which, when wet, accelerates rusting. We have prepared a statement, which appeared on page 850 in the November 7 issue of the Railway Age, showing the cost of maintaining car bodies, in which the calculations are based on an average length of life for the plain carbon steel, which is ten years between Class 1 repairs. The results in columns one to four, inclusive, are from actual data, while those in column five are averages of the other four. The estimates of materials and costs of maintenance for copper bearing steel cars represent an anticipated 50 per cent greater durability than for the plain carbon steel cars, or a 15 year service prior to Class 1 repairs. No allowance is made for painting the cars or for any repairs to the underframes, trucks or brake equipment. The increased cost of cars due to the use of copper bearing steel is shown. This is obtained by applying the differential of $3.00 per ton which has prevailed between plain carbon and copper bearing steel plates. This amount may diminish when the amount of copper bearing scrap now being used by the steel makers is increased. In making the calculation, allowance is made for losses in fabrication caused by shearing and punching. It is shown that the 135,523 cars involved would have cost $2,509,295.86 more if they had been made of copper bearing steel. The statement shows the amount of new finished plates, shapes and rivets, as well as the cost of material and labor, including shop expenses, required to dismantle and rebuild car bodies. If these cars are given Class 1 repairs over a period of ten years, using plain carbon steel sheets, the annual cost under present market conditions amounts to approximately $5,069,112.04. From the experimental data at hand to date, it may be assumed that with the use of copper bearing steel, the interval between Class 1 repairs will be extended over a 15-year period and repairing with copper bearing steel sheets reduces this cost to approximately $3,473,710.30. This represents an annual saving of $1,595,401.73 and an annual reduction of 22,385 tons in the amount of new steel required.

Those who have not given this subject special study may wonder why copper is a protective measure and what connection it can have with protective coatings. Those who have had practical experience with steel may have noticed that ordinary steel forms a light brown, loose rust on oxidation, while copper bearing steel oxidizes on the surface to a dense, dark brown, adherent coating, and this



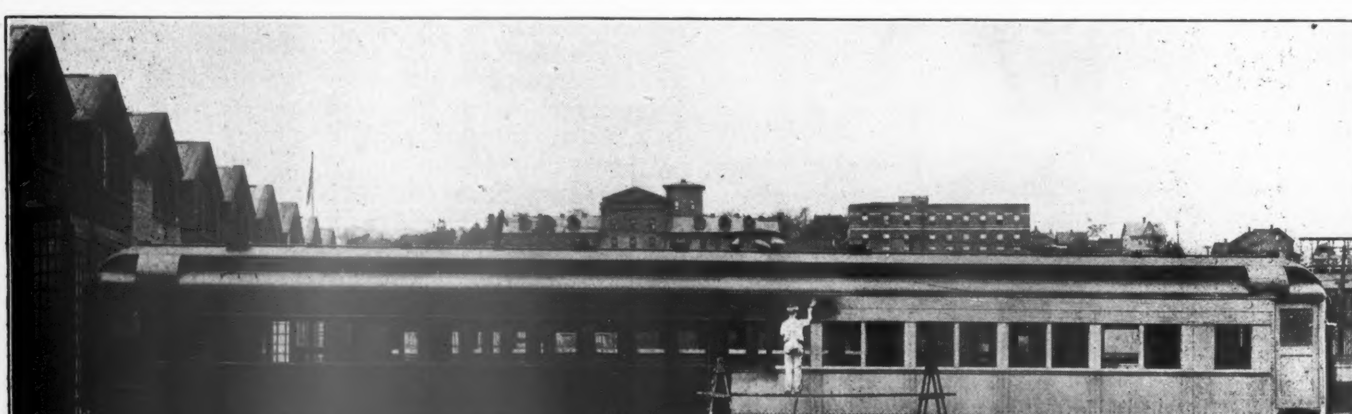
No.	C	Mn	P	S	Si	Cu
1	.100	.360	.031	.031	.023	.000
2	.045	.075	.008	.039	.028	.000
3	.056	.290	.109	.033	.004	.000
4	.078	.290	.096	.030	.014	.000
5	.052	.070	.005	.020	.040	Trace
6	.082	.030	.002	.011	.026	.028
7	.024	.060	.044	.012	.023	.032
8	.047	.060	.041	.015	.056	.046
9	.036	.030	.007	.011	.056	.052
10	.095	.350	.030	.030	.018	.070
11	.049	.050	.009	.017	.042	.140
12	.024	.060	.007	.033	.033	.140
13	.027	.040	.005	.033	.033	.146
14	.118	.360	.013	.023	.014	.249
15	.118	.370	.017	.018	.033	.258
16	.040	.070	.007	.025	.018	.264

Variations in the rate of corrosion of steel

is believed to act as a protective measure against rapid destruction.

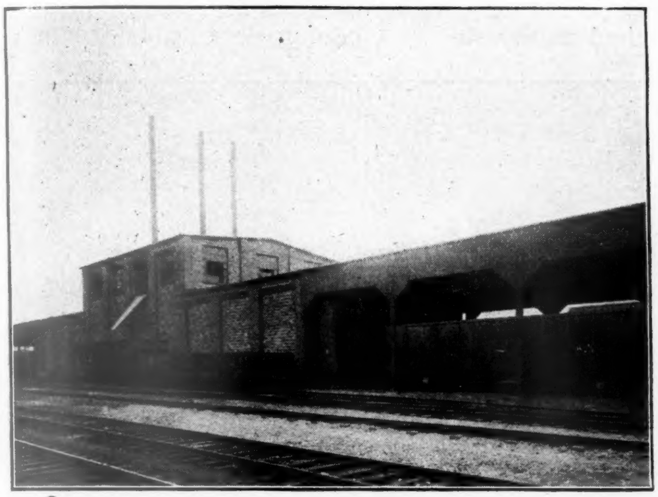
Method of protecting the surface of construction steel

The duties of the engineer do not end with the purchase of the best commercial structural metals now available. Steel for important structures, such as bridges, should



Applying Tuscan red lacquer finish to a car

receive a shop coat of good paint prior to its shipment from the factory and for this purpose red lead is still a favorite. Steel for rolling stock which is not painted should be stored in a dry place until it can be assembled and if this is not feasible a protective coat of some kind should be applied. The method employed by the Pennsylvania System, and we believe by numerous other concerns, is to apply a petroleum oil coating which contains resins and wax, these constituents being added to the oil for the



Baking ovens located at the Pitcairn car shops, which turn out 23 freight cars every 16 hours

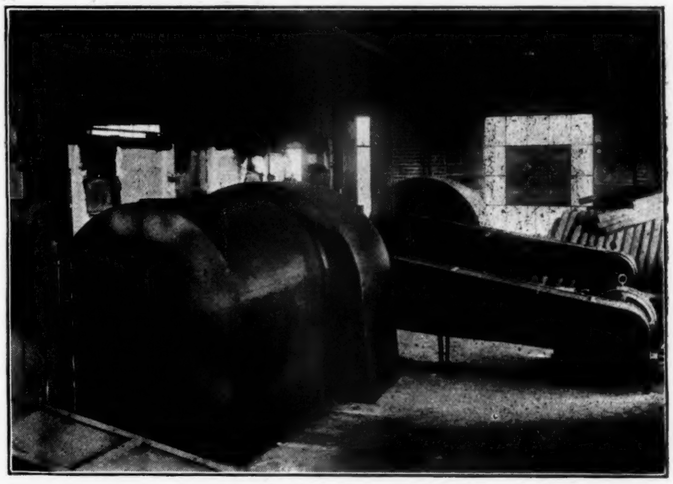
purpose of imparting adhesive properties. On withdrawal of the steel from storage for use, the temporary protective coating is removed. After construction, exposed steel parts should be well painted. Many technical organizations, including our research staff, have devoted a large amount of work towards determining the most durable paints which can be applied. Experience teaches us that

Baking ovens first designed and used at Altoona, Pa., 1913

the best air drying paints are those which contain suitable pigments, good oil and a minimum amount of drying constituents, such as Japan drier. Paints made in accordance with these precepts, dry slowly, and under conditions prevailing in industrial centers, the coating is likely to become contaminated with dirt before the paint film is set. Furthermore, the use of such paints on rolling stock keep it in the shops and out of service. Painters know that an excessive amount of driers shortens the life of paint. The action of the driers does not cease when the paint film has become dry, but continues after the purpose for which they were added has been accomplished. This leads to premature destruction of the paint film and while the fact is generally known, we have confirmed it by panel tests. Notwithstanding the known detrimental effect of these driers, painters sometimes use them in excess in order to get the equipment out of the shops in the shortest time possible.

Baking paint on passenger equipment

A laboratory baking oven was constructed and a large number of painted panels prepared, using different compositions. These panels were exposed on a test rack in comparison with panels painted with the usual air drying paints and varnishes in use. The panel tests showed that the baked coatings had greater durability than the air dried ones. The difference was so decided that a baking oven for passenger cars was constructed at the Altoona paint shops. The first car painted by the baking process was finished in January, 1913. One of the illustrations shows the exterior of this car after 40 months'



Fan and hot air furnace which supply the Pitcairn baking ovens

service. The paint was in good condition. Another illustration shows a car painted by the baking system in November, 1913, and photographed September 22, 1925. During this period, the car was in the shops for baking class repairs at three different periods. No color or varnish has been applied to it since June, 1923. These class painting repairs consisted of one coat of color and two coats of varnish to the exterior, and one coat of varnish to the interior. Cars painted by the baking process require class repainting every 36 months, while those painted by the air-dry process receive class repainting at intervals of 18 months. It requires 14 working days to paint a new passenger car by the air drying process, while by the baking process all of the painting operations can be applied in six working days. The baking process reduces the time which passenger cars must be retained in the shops on account of painting operations more than 60 per cent. There are now three baking ovens in service. One of them is illustrated which is 90 ft. 3 in. long, and will accommodate the largest cars in service. They are equipped with ventilators, and are heated by steam under a pressure of 125 to 150 lb. Each oven contains 2,000 sq. ft. of radiating surface. Temperatures of 250 to 260 deg. F. are obtainable. Baking paints, also the priming

and surfacing coats for passenger equipment cars, are dried in three hours at these temperatures. Varnish and light colored enamels used for the final coats on passenger cars darken at high temperatures. In practice they are dried in three hours at temperatures of 150 to 160 deg. F.

The coatings as applied to passenger cars by this method have been found to be very durable. All steel passenger cars from which it is necessary to remove the old paint are sent to Altoona, Pa., to be repainted by the baking process. All cars painted by the baking process are marked, and when they require class painting repairs, the additional colors and varnishes applied are dried in these ovens.

Baking paint on freight cars

In addition to the baking of paint coatings on passenger cars, the method was applied to some 1,100 freight cars in 1913. These were coal cars which were in need of paint. They were given one coat of baking paint in which different oils were used, including Menhaden fish, corn, cotton seed and soya bean oils, with linseed and China wood oils. None of the paints used contained artificial driers. The paint on these cars was dried in an oven at South Amboy which was used for thawing cars of frozen coal which were to be dumped into boats. The temperature obtainable was 185 to 195 deg. F. and it

Car finished by the baking process November, 1913—Photographed October 22, 1924

required six or seven hours to dry the paint. The cars were repeatedly inspected for about five years and the results obtained were so satisfactory that baking ovens were authorized and built at the Pitcairn car shops in 1923.

The Pitcairn installation is shown in one of the illustrations. It will be seen that they are different from the Altoona ovens previously described. There are three units over parallel tracks, each of which will accommodate three freight cars at one time. Each unit is provided with a coal-fired hot air furnace containing 40 tubes through which air is circulated by means of fans. The air to be heated is drawn from the top of the baking oven, passed through the tubes of the hot air furnace, and forced back to the bottom of the ovens through suitable ducts. The circulation of the air from the ovens through the furnace is continuous. However, provision is made for a little ventilation. A vent is provided for discharging some hot air from the top of the ovens to the atmosphere, and this loss is replenished with fresh air which is drawn through an intake into the plenum chamber of the fans. The furnace, the fans and the motors which operate them are illustrated herewith. These ovens permit the control of any desired temperature up to 360 deg. F. The time required to dry the paint coating depends on the temp-

Condition of the exterior panel of the first car finished by the baking process after 40 months' service

erature. If the ovens are operated at 225 to 250 deg. F., the painted cars are allowed to remain in them for three hours, and at 275 deg. F., the time is reduced to two and one-half hours. Thirty-two cars are now painted daily at Pitcairn. Each car receives two coats of paint, both of which are baked from two and one-half to three hours, after which they are stenciled. The paint is sprayed on, and two shifts of painters perform the work. It is possible by this method to apply two coats of paint and stencil the cars in one full working day after the cars are delivered to the paint shed, it being understood that due to two shifts of employees, a working day is 16 hours. No artificial driers are added to the paint used and a large percentage of Menhaden fish oil is used in thinning the paste paint, which is ground in linseed oil. A small percentage of China wood oil is used, as our tests and experience indicate that this addition increases the water resisting properties of the paint film. It is estimated that the time saved in painting cars by this operation is two days. In other words, the cars are available for two more days revenue service. By this method of painting cars, unexpected delays due to failure of the paint to dry on account of bad weather conditions is not experienced. The method will likely be extended to other shops.

Lacquer method of painting equipment

The extension of the baking system for passenger cars to other shops has been deferred pending the outcome of tests which are being conducted with the lacquer system which has recently revolutionized the method of painting automobiles. These lacquers contain a colloidal solution of nitrated cotton and varnish gum in a mixture of volatile solvents, which usually include ethyl acetate, anhydrous alcohol, benzene or toluene and other volatile constituents. Pigments are incorporated with this solution to give the

desired color, and to make the resulting film durable. Lacquers of this type dry so quickly that they cannot be satisfactorily applied by means of a brush. They are applied with spray equipment. The Pennsylvania System now has five passenger equipment cars and over 100 locomotives which were finished with lacquer. The operation of finishing the exterior of a passenger car with tuscan red lacquer is shown in one of the illustrations. The exterior of a car can be coated without difficulty. There is some trouble in finishing the interior of cars due to the fact that several colors are used. If the headlining is to be light green, the body of the car bronze, and the base dark green, any one of the colors can be applied, but in the application of the adjoining color by means of a spray gun, it is difficult not to spoil the first color applied. Another difficulty is encountered if it is desired to apply gold striping or lettering over a lacquered surface. The gold must be protected, and this is now done by pencil varnishing it. This is a time consuming operation. The lacquer coating can be quickly applied and successive coats can be sprayed at intervals of about 30 min. Means will probably be devised for overcoming the present difficulties. When properly made, applied and polished, these nitrocellulose base coatings present a pleasing effect suggestive of refinement. Lacquer finishes can be cleaned more easily than the more familiar varnish coatings.

The progress in the development of rust preventives has been rapid during the past decade. The successful engineer must ever be alert to the end that his client may receive the benefit of the best information obtainable.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Interchange Rule 32 again upheld

On January, 1923, St. Louis, Troy & Eastern empty coal car No. 1034 was being handled in switching service by the Chicago, Rock Island & Pacific, during which time it was broken in two while making a coupling. The car owner received a request from the handling line for a disposition of the damaged car to which was attached an inspection report which in substance showed that all of the eight sills were broken in 32 different locations and that the car body was practically demolished. It was estimated that it would cost approximately $1,000 to repair the car. The car owner sent several inspectors to examine the car and after receiving their report, advised the handling line that in its opinion the car had received unfair usage and agreed to settle according to A. R. A. Rule 112. On March 29, 1923, the Rock Island refused to handle the car according to Rule No. 112 and stated that the damage was due to decayed side sills. On April 12, 1923, representatives of both companies made a joint inspection of the car body after which both agreed that the eight side sills had been broken in 32 different places. The car owner based its contention of unfair usage on the fact that the body of the car had been turned over on to the opposite track although the trucks still remained on the track. This indicated that the car had been coupled on at a speed exceeding the limits of safety, which constitutes unfair usage according to A. R. A. Rule 32, Section D. The handling line stated that the car had not been subjected to unfair usage for according to testimony by the engine and yard crew, the coupling was made at a speed of from two to four miles per hour. There were no other cars damaged at the same time, neither was car No. 1034 or any other car derailed. The car failed owing to the fact that the sills were decayed on top in the center which was not fully disclosed until the decking had been removed. With these facts in mind the handling line took the position that the damage occurred in ordinary switching and inasmuch as the car was not derailed, cornered, sideswiped, or subjected to any other unfair usage as defined in Rule 32, the car owner should furnish disposition in accordance with Rule 120.

The Arbitration Committee rendered the following decision, "There is no evidence that the car was subjected to any of the unfair usage conditions of Rule 32. The car owner is responsible."—*Case No.* 1338, *St. Louis, Troy & Eastern vs. Chicago, Rock Island & Pacific.*

Labor charges for testing and adjusting steam coils on tank cars

The Pierce Oil Corporation, at its Sand Springs, Okla., plant, tested and adjusted the steam coils in A. T. & S. F. tank car, No. 96064 and in 17 other cars and submitted a bill for $30.45 to cover labor charges. The owner requested cancellation of these charges claiming that the work should have been considered inspection and under Rule 108 of the 1920 Code of Rules, no labor charge should have been made. The handling line stated that the tank cars were sent to its refinery for fuel oil loading and in accordance with I. C. C. regulations, Section 2, Article 1822E, the tanks and fittings of these cars were inspected and found to be in a defective condition due to leaks, making it necessary to tighten up loose and leaky connections. The handling line further contended that it was in no way responsible for the leaky condition of the cars and that Rule 108 applies only to ordinary train yard inspection and has no bearing on inspection or repairs to the parts in question.

The Arbitration Committee in rendering its decision stated that, "Rule 108 prohibits a labor charge for inspection of cars, tightening unions, etc. Therefore, the bill of the Pierce Oil Corporation should be withdrawn.—*Case No.* 1339, *Atchison, Topeka & Santa Fe vs. Pierce Oil Corporation.*

Labor charges for application of wood end posts with metal fillers

The Illinois Central rendered the following bill to the Southern Pacific for the application of wood end posts with metal fillers:

2 wood end posts at 5.5 hr. each, total	11 hrs.
2 metal end posts filler plates	
20 metal end posts filler plate bolts at 0.2 hr. each	4 hrs.
Total	15 hrs.

The Southern Pacific took exception to this bill on the grounds that the four-hour charge was excessive for applying the metal plates to these posts. It further contended that the labor charge for applying these posts is based on the material charge for lumber for the posts and wrought iron for the fillers which contemplate the framing of these posts and according to Rule 107 the labor allowance for the application of posts to cars includes all work necessary to complete each item of repair unless the rules provide that additional labor may be charged, and that as Rule 107 does not provide additional labor for the

application of fillers and as the item of repairs is not complete until these plates are applied, the arbitrary charge of 11 hrs. cannot be exceeded. The Illinois Central contended that the bill was correct in accordance with Item 249 of Rule 107, inasmuch as it does not list such bolts among the items intended to be included in the labor charge of 4.4 hrs. for a post. Furthermore, because few companies have their cars equipped with end post plates, the Illinois Central maintained that the committee omitted the charge of 4.4 hrs. for end posts renewed, and that therefore, the Southern Pacific's reference to the first paragraph of Rule 107 has no bearing whatever on the question.

The Arbitration Committee in rendering its decision stated that "The total labor charge should be reduced to 11 hours, which is the average allowance permitted in Item 249, Rule 107 of the 1921 Code.—*Case No. 1341, Southern Pacific vs. Illinois Central.*

Interchange inspectors' discussion of new rules

Report and discussion of C. S. Cheadle's paper on the prevention of transfers and claims arising from transfers also included

Aside from the presentation of papers, abstracts of some of which have been published in the two preceding issues of the *Railway Mechanical Engineer,* the second and the last day's sessions of the Chief Interchange Car Inspectors' and Car Foremen's Association convention held at Chicago, September 22, 23 and 24 were devoted principally to the discussion of new interchange rules. These rules are abstracted in this issue, together with a highly constructive paper on the subject of transfers and the claims arising from them, by C. S. Cheadle (R. F. & P.).

Prevention of transfers and claims arising from transfers

By T. S. Cheadle

Chief car inspector, Richmond, Fredericksburg & Potomac.

The transferring of carload freight affects the service expected of railroads and causes losses of revenue to shipper or consignee as well as the railroads. It affects all departments of a railroad to such an extent as to demand the careful attention and co-operation of every one having to do with shipments in an effort to reduce the enormous loss suffered as a result of transferring the load enroute.

The transfer problem on the railroads is as old as their institution and was the main factor in bringing about standardization of track gage and car parts. There are a number of men in railroad service today who remember changing car trucks at interchange points to prevent transfer of passengers and freight and expedite movement of cars.

In the table is shown the result of a check of cars transferred from January 1, 1925, to June 30, 1925, inclusive, by the railroad with which I am connected. The transferring was done in connection with interchange of cars by seven Class I truck line roads under point arrangements and no doubt represents the average condition under A. R. A. Rules of Interchange.

It will be noted that more cars were transferred on account of conditions over which the mechanical department had no control than for ordinary wear and tear mechanical defects.

No way has been found to overcome the loading of house cars which are too high and wide. A card has been printed, worded as shown in Figs. 1 and 2, with the dimensions shown on the opposite side for routing through the Potomac yard gateway. For some time these cards have been attached to all cars when empty on our road. This was done with the view of informing agents, inspetcors and shippers of the unsuitability of cars for shipments routed through the Potomac yard gateway. If

RICHMOND, FREDERICKSBURG & POTOMAC R. R. Form M. P. 102

THIS CAR TOO HIGH AND WIDE FOR NORTHBOUND MOVEMENT THROUGH POTOMAC YARD

DO NOT LOAD VIA THIS ROUTE AS IT WILL NECESSITATE THE TRANSFER OF LADING

Fasten on Car With Six Tacks, Three on Top and Bottom Edge.

Fig. 1—Front of card applied to cars too large to pass through the Potomac yard, R. F. & P.

it could be arranged to stencil all cars which exceed the standard dimensions, it would be a great benefit. However, under Car Service Rule 14, the receiving line is chargeable with the cost of transfer and unless this is made a loading line responsibility some will continue to load such cars.

The matter of cars being transferred on account of being unsuitable for perishable commodities which do not require icing; that is, ventilated cars loaded instead of refrigerators, is being handled by a special committee and test is being arranged to determine the suitability of the ventilator car as compared with a refrigerator car, where icing is not required.

The cost of transferring overloaded cars is chargeable to the delivering line; however, cars often pass several interchange points before being stopped. It should be made a loading line responsibility. This would often result in cars being delivered without being transferred.

No rule can be devised that will overcome the necessity of the mechanical department closely supervising or having charge of the transferring of cars. In every case, a

thorough inspection should be made by a competent inspector, one who is thoroughly familiar with shop track work and who is capable of using sound judgment in deciding whether a car should be repaired or transferred. Where this is not being done, if adopted, it will overcome a large number of transfers now being made.

Mechanical defects causing transfer are the result of poor design, improper construction, rough or improper handling (largely from use of the independent air brake), failure as the result of age, due to decaying, corroding, or wearing out and breaking as the result of fatigue, the misuse of the car in loading a commodity for which it is not suitable, improper loading and leaking tank cars.

WIDTH LIMITS FOR CARS AND LOADS
NORTHBOUND VIA POTOMAC YARD
Centre to Centre of Trucks

Height Above Top of Rail		30 Feet				40 Feet				57 Feet			
		Cars		Loads		Cars		Loads		Cars		Loads	
Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.	Ft.	In.
15	6	1	11	..	..	1	10	..	..	1	9	..	..
15	3	3	0	1	11	2	11	1	10	2	10	1	9
15	0	4	6	3	0	4	5	2	11	4	4	2	10
14	10	5	0	3	10	4	11	3	9	4	10	3	8
14	8	5	10	4	9	5	9	4	8	5	8	4	7
14	6	6	6	5	7	6	5	5	6	6	4	5	5
14	4	7	1	6	3	7	0	6	2	6	11	6	1
14	2	7	9	6	10	7	8	6	9	7	7	6	8
14	0	8	4	7	4	8	3	7	3	8	2	7	2
13	10	8	9	8	1	8	8	8	0	8	7	7	11
13	8	9	1	8	6	9	0	8	5	8	11	8	4
13	6	9	3	8	9	9	2	8	8	9	1	8	7
13	4	9	6	9	0	9	5	8	11	9	4	8	10
13	2	9	8	9	2	9	7	9	1	9	6	9	0
13	0	9	11	9	5	9	10	9	4	9	9	9	3
12	10	10	0	9	6	9	11	9	5	9	10	9	4
12	8	10	3	9	9	10	2	9	8	10	1	9	7
12	6	10	5	9	11	10	4	9	10	10	3	9	9
12	4	10	8	10	2	10	7	10	1	10	6	10	0
12	2	10	10	10	4	10	9	10	3	10	8	10	2
12	0	10	11	10	5	10	10	10	4	10	9	10	3
11	9	11	0	10	6	10	11	10	5	10	10	10	4
11	6	11	0	10	6	11	0	10	6	10	11	10	5
11	3	11	0	10	6	11	0	10	6	11	0	10	6

The equivalent width is the doubled distance from the center line of track to an outside point in line with widest part of car. Height, is from top of rail to highest point of measurement.

Fig. 2—Reverse side of the card shown in Fig. 1

Tank cars should be tested under oath to prevent a car being stencilled and put in service without proper test having been made.

The present standard and recommended designs, deserve the praise of all car men. Nevertheless, there is considerable shop track practice in rebuilding and repairing that should be avoided or condemned. Poor repairs are nothing but an expensive bad habit and often good permanent repairs can be made for less than a patched up botch job.

With the varied standard of inspection, the present rules are ideal for creating transfers. Any change in rules would help to prevent them. However, it is logical to suppose that a rule which should make the car owner or loading line responsible for transfer costs on account of ordinary wear and tear, would be progressive and equitable; it would leave it to the judgment of the car inspector as to whether a car was safe to reach the next point of inspection. If the owner was responsible, it would make it profitable that the car be kept in repair.

TRANSFER

INITIAL ______ NUMBER ______ DATE RECEIVED ______ 19__ FROM ______ KIND ______ DEFECT O or N

CAUSE FOR TRANSFER ______

IF OVERLOADED SHOW CAP. ______ TARE WT. ______ NET WT. ______ GROSS WT. ______

POINT OF ORIGIN ______ DESTINATION ______

SIGNATURE OF PARTY AUTHORIZING TRANSFER ______

TIME RECEIVED ______ INSPECTOR OR YARDMASTER. 7-10-22 6M

Richmond, Fredericksburg & Potomac Railroad Co.

ADJUST

Initial ______ Number ______ DATE RECEIVED ______ 19 From ______ Kind ______

Load Defects ______

Car Defects ______

Time Received ______ M ______ Inspector ______

Fig. 3—(Above) Front side of card to be attached to cars shopped for transfer of lading—(Below) Reverse side of the same card—Both sides are red, printed in black

At the same time the cost of switching and per diem would penalize the carrying line sufficiently to cause the movement of the car without delay and would result in the owner being willing to permit and accept charges for temporary repairs rather than to pay the cost of transfer.

The majority of car men will agree that an inspector has exercised good judgment and performed his duty properly when he passes a car safely to the next point of inspection. This, however, cannot be done under the present rules without penalizing his line, and the inspector has to anticipate what will be the judgment of inspectors at every interchange point which the car will pass en route to destination, and in doing this cars are shopped and transferred which should run. This brings about a point of view that "if you will not, I will not." This also applies to improper loading, use of small stakes and tie boards, and improper bracing.

A rule that would give chief joint car inspectors, or some competent car man where there is no joint inspection, at principal gateways, the authority to route a car home to the owner when in need of rebuilding (Car Service Commission to enforce repairing of car) would prevent

the loading of worn out cars more than any one thing and would increase greatly the average miles per day of loaded cars. In addition, the definition of a serviceable empty car should be changed to read, "A car suitable for any commodity for which it is intended to be used." And will be used for when it is loaded. He, therefore, has no opportunity to exercise his judgment.

A summary of things that would prevent transfer includes equipment of good design and construction; substantial repairs to old equipment; a change in rules which

Form P. Y. 1098 10-24-23 5M

Richmond, Fredericksburg and Potomac R. R. Co.

Potomac Yard—Bulk Transfer

________ Car No. ________

Lading ________

From ________

To ________

Final Destination ________

Routing ________

Shipper ________

Consignee ________

Gross ____ Tare ____ Net ____

Capacity of Car ________

Seals arriving West ________

" " East ________

Road off ____ Date ____ Time ____ M.

LADING TRANSFERRED TO

________ Car No. ________

________ Car No. ________

________ Car No. ________

Cause of Transfer ________

Date of Transfer ________ 192__

If for exceeding dimensions—show same.

Height ____ Width ____

C to C ____ Overall ____

Responsibility for Transfer ________

Lading Consists of ________

Fig. 4—Record card on which the essential facts pertaining to a transfer of lading are recorded for the use of the claim department

Condition of lading upon receipt ________

____ Exceptions by ____

Shipment checked ________

Time original car was placed ________

Amt. ice ____ Vents ____ M.

" " in receiving car when placed ________

" " transferred with lading ________

Time completed ____ M. Reported ____ M.

Condition of vents and bunkers—receiving car.

Amt. ice ____ Vents ____ Temp. ____

Seals applied to receiving cars ________

NAMES OF WORKMEN

Price allowed laborers ________

Inspector of lading charge ____ Total ____

Remarks: ________

Fig. 5—The reverse side of the record card is a continuation of the information for the claim department

for a loaded car, "One which will carry its load safely to destination." This is necessary for the reason that it is rare in interchange that an inspector knows what the car will enable inspectors to use their judgment as to the safe movement of the car; a rule which will make it profitable for the handling line to run the car and also make it

profitable for the owner to repair, adding a rule by which worn out cars can be sent home for repairs, and giving a definition of an empty car which will work in interchange.

The prevention of claims as the result of transfer is a very hard matter to overcome, as it appears that the consignee almost invariably accepts the knowledge that transfer was made as an invitation to make a claim.

It is thought by a good many mechanical men that claim departments deal too largely in a stereotyped manner, in securing information by the use of forms, widely distributed, among men who often carelessly furnish information which is not based on a knowledge of the facts and the consignee is sometimes furnished with information which encourages claims.

The prompt handling of a car shopped for transfer is one of the most important points in connection with this subject, as delay increases the possibllity of a claim. When a car is shopped for transfer, a stiff conspicuous tag, as shown in Fig. 3, should be attached to the car. The car should be placed promptly, together with a car in good order. The latter should be a good looking car as it is human nature for the consignee to be affected by the looks of the car in which the load is received; transfer tracks located conveniently to the switching territory, properly spaced, will add materially to the quick transferring of the car. Proper supervision of the transfer forces is another of the most essential things in connection with proper handling of the commodity and a record should be made correct in every detail for use of the claim department, such as is shown in Figs. 4 and 5. Extreme care should be exercised on practically all commodities to see that they are placed in the receiving car in a manner as near as possible like they were when originally loaded, if this loading was properly done, and that proper bracing and door protection is afforded, if necessary. Gum shoes, clean gloves and hands should be used in connection with careful handling of dressed or fine lumber to prevent marking, defacing or injuring tongues or grooves; hooks and canthooks should not be used where it will injure lading. Watermelons, canteloupes or such commodities should be topped as near like the original load as possible. Baskets should be provided for handling bulk apples, oranges or such fruits, that are liable to bruising in handling. A record should be required of yard and mechanical forces showing the delay and its cause in handling cars for transfer.

Statement of cars transferred, showing the defects making such transfer necessary and the total cars handled in interchange by the R. F. & P. with the A. C. L., B. & O., C. & O., Penna., S. A. L. and Southern from January 1 to June 30, inclusive, 1925.

Loaded cars interchanged		513,594	
Empty cars interchanged		100,682	
Total		614,276	
Cost	$12,735.36		
High and wide house cars		897	
Not suitable for perishable lading		295	
Ends knocked out		177	
Overloaded		79	
Fire damaged		1	
Wrecked		24	
Shipper's request		18	
Damaged lading		1	
Total			1,492
Center sills		172	
Truck bolsters and transoms		127	
Bulged		92	
Truck sides		85	
Body bolsters		71	
Leaning in center		60	
Draft gear		46	
Center casting		26	
Safety appliance		22	
Side sills		13	
Improperly loaded		3	
Bad rigging		3	
Leaking tank		3	
Car floor		1	
Total			734
Grand Total			2,226

It appears that no accurate data have been compiled to show loss as the result of transferring cars. It is estimated by various sources that all cost considered, losses will average $60 per car. Under any condition the cost is high, and the management of railroads, when they fully realize the effect, will apply a remedy.

Discussion

Mr. Campbell: I heartily agree with Mr. Cheadle's paper. I think it would be beneficial to the railroads to spend more money to repair cars rather than to transfer and especially with many commodities that are liable to damage claims, like automobiles. At Minneapolis, we make it a point not to transfer automobiles. We are spending $50 to $60 a car to avoid it. If the railroads will do more of this thing, they would get away from a lot of claims.

Mr. Hanson: I would like to ask Mr. Cheadle who handles the cards which he showed here, the joint inspector or the transportation department?

Mr. Cheadle: All the cards are handled by the inspector with the exception of the cards issued for overloading, which are filled out by the transportation department man and forwarded to the man who loaded the car. The mechanical department has supervision over the transportation department on the transfer tracks.

Mr. Trapnell: I would like to ask Mr. Cheadle when he transfers a car for transferable defect what disposition he makes of the empty?

Mr. Cheadle: About 50 per cent of the cars we repair ourselves and about 50 per cent are returned to the delivering line.

Mr. Trapnell: In the month of March, 1925, we transferred 462 cars out of 125,425 interchanged. I find that out of the 572 transfers asked for we refused 110. The number of cars repaired out of 462 was 81; number of cars not repaired, 381; number of cars not repaired and loaded out from point where they were transferred, 96; number run out empty to go out and get other loads, 114; number stored for repairs, 73, and number moved home empty, 76. Cars that should have been repaired by the receiving line in 20 or more hours were 258. We are throwing away the money of the railroad companies which we represent by the wholesale when it costs us 25 cents a minute to switch the car; in addition we frequently have to pay per diem for the car while it is held, to say nothing about loss and damage freight claims.

Discussion of freight car rules

Rule 2

The committee recommends that Bureau of Explosives' Pamphlet No. 20-J be incorporated in the next issue of the rules as an addendum for the information of car inspectors, with a designating mark opposite Section (b) of Rule 2 calling attention to same.

The committee recommends that second paragraph of Section (h) be modified as follows:

Proposed Form—For inside door protection, *side or end*, the car transfer check, issued by the road having car in its possession, shall be authority for bill against road on which load originated, for cost of adjusting load due to absence of, or improper inside door protection, as well as cost of applying or correcting such protection. (See Section (e) A.R.A., Car Service Rule 14.)

Reason—To harmonize rule with action of joint conference between Mechanical and Transportation Divisions.

T. J. O'Donnell (Buffalo, N. Y.): Is it understood by all that the rule would apply to a small end door window or would it apply only to an end door?

T. S. Cheadle (R. F. & P.): It has been my impression that it would apply to any end door.

Mr. O'Donnell: How are you going to hold the loading road responsible and how are you going to charge for

the cost of adjusting the load, due to the absence of proper inside door protection?

Mr. Cheadle: By what our committee rules, I think the delivering line really stands for any small end door protection that we have to apply.

Mr. O'Donnell: Will the delivering line understand that the charge is for any end door?

Secretary Sternberg: In my opinion Mr. O'Donnell is correct. I do not think the intention is to go so far as the small end door.

Mr. Cheadle: It is my position that it would apply only to vehicle door but as the rule reads it would apply to any end door; I do not think in the case of some kinds of lading they would insist upon protection against the end door.

C. J. Nelson (C. I. E., Chicago): It is my opinion that the rule as it is now written will probably only be applied to the vehicle cars, in the majority of cases. I think that Mr. O'Donnell probably has in mind the small end door which is being used on cars today but there is a possibility of end doors of different design being applied to cars in the future and it seems to me it does no harm to include small end doors. There are times when the shipper really should cover the end door when he puts certain kinds of loading regardless of how small it may be and as I understand it the labor charge is actual and cannot be a great burden to anybody, to render a bill against the originating line for necessary protection on the small door. I quite agree as to the necessity of having to remove the load on many occasions to apply this end door protection which may not amount to a great deal, but I see no reason why the receiving line should assume that expense and it seems it would be very well to take the rule literally.

G. Lynch (Cleveland, O.): I think the proper method of procedure would be to make a motion to refer this matter to the Arbitration Committee for decision.

F. W. Trapnell (Kansas City, Mo.): I move that it is the understanding of this body that the rule includes any end door. The motion was carried.

Rule 4

The committee recommends that the second paragraph of this rule be changed as follows:

Proposed Form—Defect cards shall not be required for any slight damage (new or old) that of itself does not require repairs before reloading of car, *except that the car may be used, under load, in movement to shop for the required repairs.*

Reason—The recommended modification is a reasonable exception to the general rule, which contemplates that cars with defects requiring repairs shall not be continued in service indefinitely. The general restriction against reloading defective cars is advisable as a measure against the improper issuance of defect cards for unnecessary repairs.

With reference to second sentence of present rule, the experience has been that in many cases it is practically impossible to determine whether the defects were new or old.

Mr. Bell: It occurs to me in connection with this, that a car might be unloaded and reloaded before it returns to the owner, so that the wording of the rule gives the owner no protection in that case.

Rule 8

G. P. Zachritz (M. St. P. & S. S. M.): The note after Rule 8 which refers to the changes in the billing and wheel repair cards and provides that the present repair card (used at that time) may be used until the supply is exhausted. The note contemplated that when that supply was exhausted the roads would supply billing repair and wheel repair cards as shown on Pages 199 and 201 of A.R.A. Rules effective January 1, 1925.

Some of the roads are still buying repair cards and wheel repair cards which are not standard. Some of them have an additional column headed "money," and instead of using the "net price" column for all items expressed in money they divide the items between the "net price" and money columns.

Some of the roads do not put the prices on the wheel repair card and some of them bunch the price of the wheels, the axle and the labor of applying wheels and carry it to the money column on the repair card which necessitates the car owners repricing the entire repair in some instances.

I suggest that the Arbitration Committee ban the use of non-A.R.A. repair and wheel repair cards and where cards are not priced in accordance with the instruction as per the different headings on the billing repair card and wheel billing repair card, it be left to the option of car owner or company billed whether to reprice and check the bill and voucher same or return it to billing line to be properly priced.

Rule 9

The committee recommends that the information to be specified on billing repair cards after item of Brake Beams, R. & R., be modified as follows:

Proposed Form—New or second-hand, applied. If A.R.A. and number of same, or non-A.R.A. Cause of removal. Location number (see Rule 14).

Reason—This information unnecessary in the proper preparation of repair records.

Mr. Herbster: At this time I wish to call the attention of the members to brake beams applied generally by a good many railroads that would not pass A.R.A. test. The road I am connected with is removing a number of beams every day with small truss rods, undersized fulcrum; in fact, any and all kinds of material applied by other railroads, or by industries, and I believe we should impress upon the members of this association that they centralize their brake beam repairs so that the work can be properly done and meet with A.R.A. regulations.

The Chair: I concur with what Mr. Herbster has said, and if all present handle accordingly it would be very beneficial.

Rule 30

The committee recommends that Section (g) of this rule be modified as follows:

Proposed Form—When a car is *reweighed and* remarked the car owner must be *promptly* notified of the old and the new weights, with place and date. The proper officer to whom these reports should be made will be designated in "The Official Railway Equipment Register."

Reason—These reports should be furnished promptly.

Mr. O'Donnell: I wish to bring out the fact that a number of roads are simply re-weighing and re-stenciling cars in large numbers and they do not put on the A.R.A. standard size stencil. The idea is that we are obliged to give joint evidence and your loss is $3, or whatever you are getting for it.

B. F. Jamison (Southern): I might add that not only many railroads are re-stenciling cars in that manner, but many car owners are not using proper stencils. Some use one size figures and some another. I was in a shop lately where they were re-weighing cars and putting the lightweight on in 12-in. letters, that was the owner's standard and they had to go cut a stencil to meet the owner's standard. That, to me, is where standard marks would benefit, and I think some of us owners better take notice of this.

J. N. Brandon (M. St. P. & S. S. M.): A great many railroads have small capacity cars that have non-standard axles. I would like to ask what practice is used on other roads in re-stenciling these cars when they are re-weighed. Under new ruling, Rule 30, we have to re-stencil all cars with suitable capacity, etc. With a car 60,000-lb. capacity with non-standard axle we have nothing in the rule to cover it, and I would like to know what method is used on the different railroads for stenciling these cars.

Mr. Herbster: Isn't it given on Page 101 on 40,000 capacity cars?

Mr. Cheadle: I think that is the answer.

Rule 32

The committee recommends the addition of a new second paragraph to this rule, to read as follows:

"Steel tank heads (on tank cars) burst, except when due to inferior material, material less than required thickness, omission of reinforcing shoes where required, burned in flanging, welds or other improper workmanship: in any of such cases handling line must furnish car owner with statement showing actual condition of tank head which caused the failure."

Reason—To protect car owner against such damage unless failure occurs under any of above described conditions.

The committee recommends that Item 4 of Section (d) of this rule be changed as follows:

Proposed Form—No rider protection when necessary, if car is damaged to the extent shown in *Rule* 44. *The same responsibility applies also, if car is damaged to the same extent (per Rule 44), due to defective or inoperative hand brake rigging while handling car with rider protection, even though such faulty conditions may have developed during the switching operation.*

Reason—The elimination of Item 4 from Section (d), and the substitution of combination factors on certain classes of tank cars to constitute handling line responsibility, as proposed by the American Petroleum Institute, is not concurred in.

The committee recommends that Item 5 of Section (d) of this rule be modified as follows:

Proposed Form—Coupling on with locomotive *when first car is damaged, including damage to adjoining cars (in consecutive order) in same draft.*

Reason—Reference to speed limit has been eliminated. The revision conforms to Interpretation No. 11.

The committee recommends the elimination of the last paragraph of this modified as follows:

Present Form—Defect cards shall not be required for any slight damage (new or old) that of itself does not require repairs before reloading of car. In no case shall defect card be required for raked or cornered sheathing, roof boards, fascia, bent or cornered end sills, if defects are old.

Reason—Covered by second paragraph of Rule 4.

Mr. Cheadle: It looks to me as though it is a big change in the rule. It used to be that if a car came over the hump with "rider protection" and damage occured it would be up to the car owner, but this new rule eliminates that. If you handle a car now with brake inoperative or defective the handling line is responsible.

Mr. O'Donnell: Why should not the man in charge of the car going over the hump be supposed to look over the car before it goes over the hump and see that nothing is wrong?

M. E. Fitzgerald (C. & E. I.): We have an arbitration decision between two Chicago lines, where the association has already recognized the fact that we must have effective hand brakes in going over he hump; we had the same protection all last year.

Mr. O'Donnell: May I put a question before you before we leave Rule 32: the change made by the Arbitration Committee "coupling on with locomotive when first car is damaged, including damage to adjoining cars (in consecutive order) in same draft." If the first car is damaged which is being coupled onto the locomotive and the second and third cars are all right and we have some damage after this, who is responsible?

Mr. Trapnell: My understanding is that if in coupling on with an engine you damage the first and second cars and the third car is O.K., but the fifth car is damaged, that the handling line would assume the damage on the first and second car, but on the fifth car the damage would be owner's responsibility, because it is not in consecutive order, providing there is no derailment.

W. P. Elliott (T. R. R. of St. L.): I would like to ask a question under Rule 32: that part relative to bursting out of tank heads. There is an exception there that when a head bursts, due to inferior material, material less than required thickness, omission of re-enforcing shoes, etc., the owners would be responsible, but the owners must be given a statement. Does the fact that you give the owners a statement change the responsibility, say, for a case of an end breaking out on a tank car due to not being properly reinforced? Why make the owners a statement if it is the owners' defect?

Mr. O'Donnell: I think the Arbitration Committee has done absolutely right in placing the responsibility in the hands of the owner. You cannot arbitrarily charge tank owners for $80 or $90 simply due to unfair usage. Give him the facts as required by the Arbitration Committee as stated "in consideration of the foregoing it would be unreasonable arbitrarily to hold the handling line responsible for defects of this character."

C. F. Straub (Reading): Before we get away from Rule 32, I would like to call attention to interpretation No. 2, which reads:

Q.—When flooring planks are cut out and can be seen from the outside of car, who is responsible?

A.—They are cardable defects where they can be seen in interchange from underneath the car.

A good many open top cars have patch boards put on them and owners do not repair them. Are they still cardable? Should not this association go on record as getting this interpretation re-written or eliminated entirely so that there will be an understanding that floor planks are only cardable when they are cut out new?

E. R. Campbell (Miss. Transfer): This is a case of defect card demanded by the owner and in checking them we find that cars are not repaired when they go home and come back again.

Mr. O'Donnell: The rule does not say that cars must be repaired when under load. If the card is taken off before the car is loaded, then they have to inspect the car.

Mr. Campbell: Nevertheless floor plank cut out is expressly mentioned as a defect and should be given necessary specific mention.

Mr. O'Donnell: Do not card unless repaired.

Mr. Fitzgerald: There is nothing in Rules 4 or 32 that provides he has to card the car owner for old floor planks cut out. Mr. O'Donnell says if he does make repairs he takes the card off and card issued is authority to bill car owners by the line that issued it. We get the car moving over our railroad and issue defect card for small defects as mentioned by this gentleman who just spoke. We card cars home to owners for repairs. We have no way of following that car up and making the owner comply with the provisions of the card, and I take it that if a card is issued for that floor plank the owner can bill as if he makes the repairs.

Mr. Straub: This is a case of car owners delivering their own cars with floor planks cut out, but patched over. We cannot always patch these when they are delivered to us, but when they go back empty it can be plainly seen, and also it can be seen that they are old defects, but a defect card can be demanded because the interpretation of Rule 32 says so. All that is necessary to clear this up is to try to get a new interpretation at this time.

F. H. Hanson (N. Y. C.): In regard to damaged tank heads, I would like to get the opinion of this association as to who is responsible. If the tank car owners must all comply with tank car specifications and put push pole pockets on the body of the tank or truck bolster, and if they place these push pole pockets on the tank head, naturally the yard or train crew who are doing the work will use the push pole pocket wherever it is located, and I think you will all agree that it will weaken the head. If we found a tank of that kind would we have the right to refuse it in interchange?

Mr. Fitzgerald: I do not know of any rule that will prohibit the interchange of that car if car is in continuous service. Rule 3 does designate certain such conditions and certain exceptions covering the interchange of tank cars, but it does not cover the general specifications and details of the car. From what I can see I do not feel that you could refuse the car, but I do feel that in the event of any distortion of head due to that push pole pocket being located on the sill of the tank it is an owners' responsibility, providing this damage is brought about by the proper use of this push pole pocket, but if the mark indicates that the switchman has applied the pole outside the push pole pocket, then it is unfair usage.

Mr. Hanson: That is the point I wanted brought out, to make it more clear to the rest of us. We recently had a tank equipped in that manner and the car was switched and struck twelve other cars standing on the track, no damage being done. Half an hour afterwards the car was found wrecked and in correspondence with the owner we called attention to the fact that the push pole pockets were riveted to the sills, and they came back and said that although they agreed that the push pole pockets were riveted to the sill of the tank they would not accept

a bill for the damage. The rule is so written that all you have to do is to make a statement of the conditions you just referred to, attach it to the billing repair card and bill the owners. Make another statement forwarding to the freight claim department and that will clear you of the responsibility.

Mr. Campbell: I would like to ask a question under Rule 32 that is not covered by the rule. That is the responsibility for damage in unloading gondola cars with the clam shell. All there is in the rule is in reference to unloading machines. This reads "material missing from cars due to handling by unloading machines." We have a great many cars in our country that are unloaded with a clam shell; they drop the clam shell in and raise the bucket from the floor, at such an angle that it breaks the side boards. Is this owners' defect or is it the handling line's responsibility?

Mr. Fitzgerald: As I interpret the rule we are supposed to go a little farther, in other words, I do not think the A.R.A. would embody in this little book of rules all the general detail of conditions under which you are supposed to use Rules 4 and 32 with reference to carding defects. They say that any damage to equipment brought about by unfair usage except under certain conditions is handling line responsibility. If you have a foreign car on your railroad and in unloading the car with a clam shell you break the car as the bucket raises or in any other manner, such as broken side stake, etc., it is a cardable defect and a handling line responsibility, the only protection you have is to repair the car at your expense and handle with the shipper through the transportation department to bring about better conditions at that plant. In a majority of cases if you talk with the shippers you can reduce the damage considerably, but it is a cardable defect.

Mr. Elliott: I consider that unloading a car with a clam shell in fair and ordinary handling will continue, and everybody is doing it. It is not cardable.

Mr. Cheadle: We do not consider a clam shell an unloading machine.

Mr. Herbster: In recent years we have contended that car construction must meet with the conditions under which it will be moved, and it is a fact that old equipment has been destroyed and owners are replacing the old equipment. I do not see why equipment cannot be put in condition to withstand ordinary handling. If the equipment does break up by reason of loading with a clam shell, I believe the owners ought to be responsible.

Mr. Cheadle: The rule says, "Material lost from cars due to handling on unloading machines." If you can get a claim charge on that I do not know how you do it. Rule 32 does not deal with the question of unloading, except in that paragraph.

Mr. Nelson: It seems to me that it would be very unfair to consider clam shell damage owners' responsibility. Some very expensive damage is done by clam shells on many of the modern cars. We have seen these hopper cars practically wrecked on the inside. I realize, however, that it is a very difficult matter to tell clam shell defect from other defects. There is no question but that many defects cards are issued today on assumed clam shell damage that should not be issued. But I agree that it is delivering line's responsibility and that it would be no more than fair to charge for all clam shell damage.

W. M. Allison (D. T. & I.): Recently we had this question up with one of our connections. We thought it a cardable defect in interchange. Meantime we wrote to Mr. Hawthorne of the Arbitration Committee and he advised that while it was not a cardable defect in interchange, it is up to the handling line where damage is done to protect car owner for such damage. Knowing we were more or less responsible for this damage, we gave card, and I believe this is in line with the Arbitration Committee's decision.

Secretary Sternberg: We in Chicago always feel that in cases of this kind we are fully taken care of by our Joint Inspection and we are satisfied.

Rule 91

The committee recommends that Section (c) of this rule be modified, a new paragraph be added as Section (d), and that present Sections (d) and (e) become new Sections (e) and (f) respectively, as follows:

Proposed Form—(c) No bills shall be returned for correction on account of other error or questionable charges unless the net amount involved is at least $1 and exceeds 10 per cent of the total amount of bill, but shall be passed for payment at once and the alleged error brought to the attention of the billing company within 60 days from date bill is passed for payment, but in no case exceeding six months after first receipt of bill. The billing road must furnish proper explanation or shall issue within 30 days countercharge authority on form shown on page 197.

(d) *If objections to bill, as per Sections* (b) *and* (c), *do not amount to $1 in aggregate, no exception shall be taken, but bill shall be passed for payment as rendered. In any case, however, if entire bill is improperly rendered, it may be returned regardless of its amount.*

Reason—To clarify the rule.

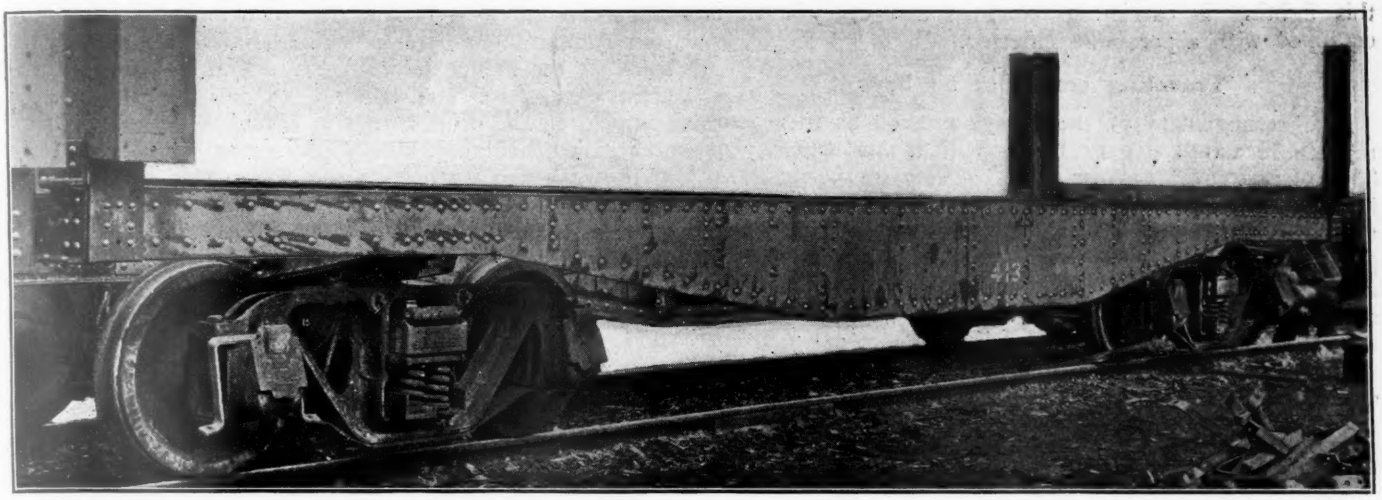
D. E. Bell (C. N.): There is a question I would like to have answered in connection with rendering bills. We have had at times some controversies on account of the similarity in car markings on several roads. It was our practice where the entire references were incorrect to render a bill, and I remember on some occasions that the other railroad companies objected to bills being rendered.

Mr. Jamison: I believe anyone from a billing office will bear me out in the statement that this particular rule is hard to live up to and by mutual consent the various railroads give and take on the proposition because 30 days is a short time in which to handle objections. That time goes by rapidly, particularly on railroads which have not adopted any progressive movement in their billing departments, such as centralization of billing. On the line with which I am connected, we have our own methods of centralization and all repair cards are prepared in the main office of the various divisions and we have been able to expedite greatly the handling by that method, and are trying as nearly as possible to live up to the letter of this rule. We have had very little trouble in handling that matter though, because the majority of the other railroads have to be lenient to others because they have to ask the same leniency for themselves.

Mr. Bell: Then no bill should be returned for correction, but should be passed for payment at once. We can correct car number or initials, but if entire bill is out of order, that is, if all the references are wrong, there is a question whether it would be handled under Section B or under Section D. In many cases the entire bill is improperly written. It has been the practice of the Canadian National to return bill if all the references were incorrect.

W. O. Watkins (H. V.): The Hocking Valley has much the same reference as the Lehigh Valley and we have never had them object to any card where the billing was wrong, nor do I believe any other road objects to the rendering of the bill.

Enginehouse view on the Union Pacific at Cheyenne, Wyo.

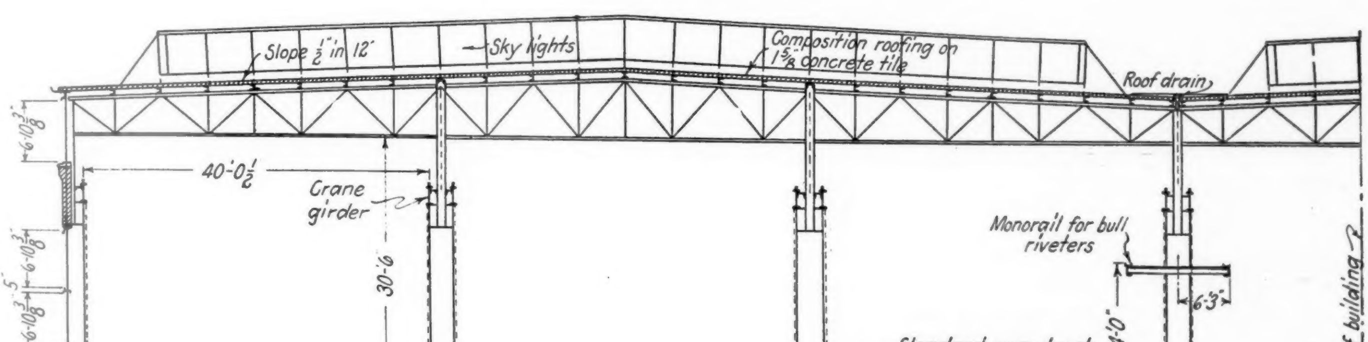


Steel underframe and trucks as received from the steel shop ready for application of wooden parts

E. J. & E. steel car shop at Joliet

Description of shop-method of organizing to rebuild twelve composite gondolas a day

FOLLOWING a fire in March, 1923, which entirely destroyed the steel car repair buildings of the Elgin, Joliet & Eastern at Joliet, Ill., this road erected a new steel car shop at Joliet featured by modern construction and equipment throughout, and with special provision for safe, sanitary and comfortable working conditions. This shop was designed primarily for the maintenance of various types of steel cars owned by the E. J. & E. but when it became necessary to re-build a wide across the front and 500 ft. long on one side. Finding it impossible to extend the other side straight back owing to the cramped condition imposed by adjacent tracks, this wall is broken by two offsets which reduce the width of the building to 171 ft. across the extreme end. The building is 34 ft. high at the eaves. Six lines of steel columns extend lengthwise, as shown in the drawing, the columns in each line being 25 ft. apart and the lines spaced 42 ft. between centers. The effect of this



Cross-section through shop—Traveling crane and monorail runways indicated

series of heavy-duty drop-end composite gondolas as described in this article, arrangements were readily made, under the direction of J. Horrigan, superintendent of motive power, and C. H. Emerson, master car builder, to turn out twelve of these cars a day, the sills and other steel parts being fabricated in the steel shop and a station method developed on an outside track for handling the woodwork. Work in the steel shop was progressing on other all-steel cars simultaneously as they went through the various departments.

The new building is a brick and steel structure 300 ft. arrangement is to divide the interior of the building into seven longitudinal bays with no partitions to obstruct the light or prevent ready communication throughout the floor area.

Ample light is afforded during the day by means of the large proportion of window area in the side walls and A-frame skylights which occur in three rows down the length of the building. The electric lighting system is also efficient, including 200-watt bracket lights on each side of each column, overhead lights of 300-watt in each bay, and numerous 60-watt drop lights. All wiring for

this lighting is carried in conduits and every light is equipped with a parabolic reflector.

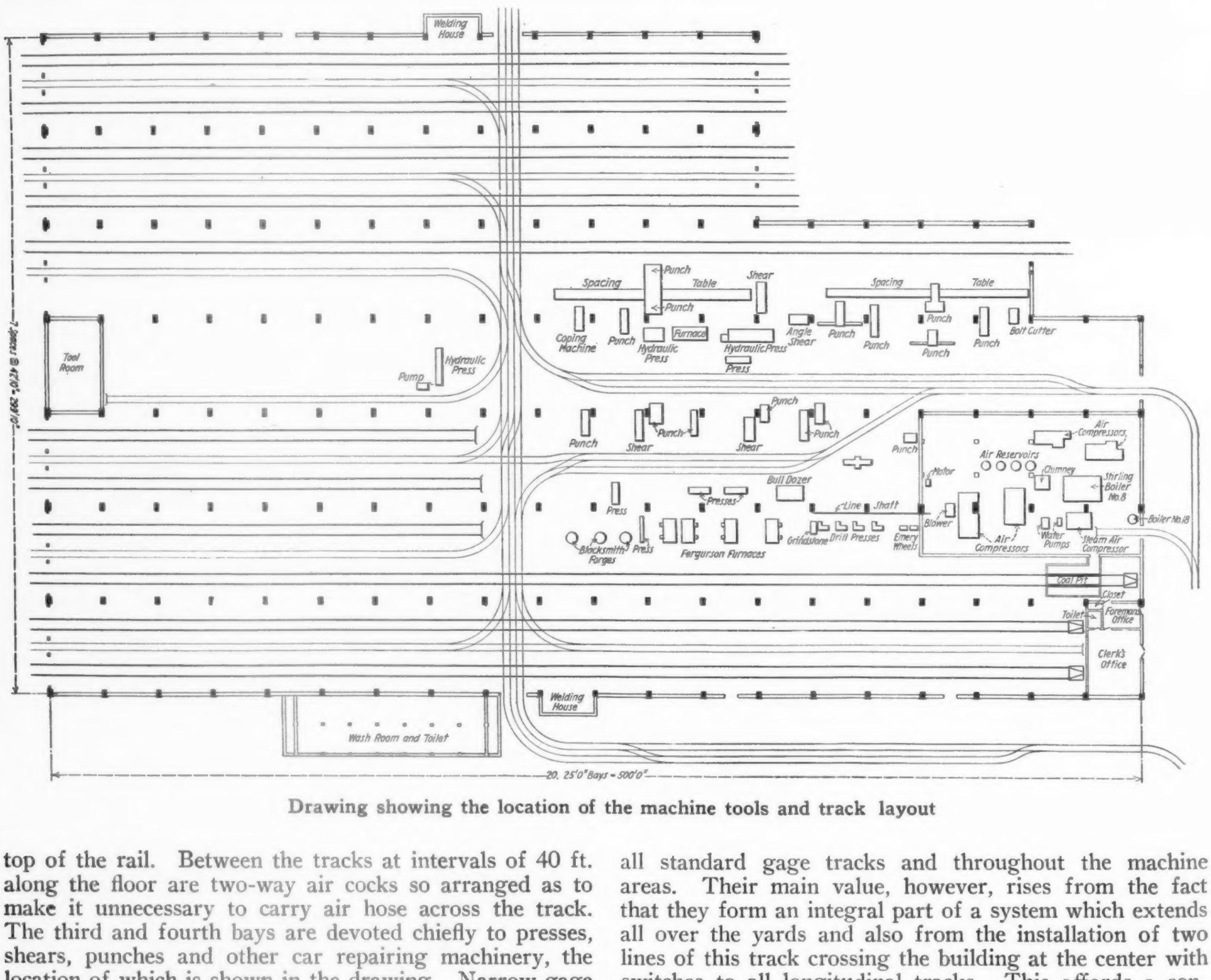
Traveling cranes in all bays

The arrangement of these bays is such as to accommodate 11 standard gage tracks with a total capacity of 85 cars and seven narrow gage tracks. In the first two bays on the north side of the building, four tracks extend through the building to a ladder at the east end which permits ready connection with the switching and storage tracks in that vicinity. This arrangement also permits the repair of cars in successive stages which has been found to expedite production. The tracks are laid on 20-ft. centers which leaves room for a narrow gage track down the center of each bay between the standard gage tracks. Six-ton traveling cranes operate throughout the length of each bay on crane ways carried 25 ft. above the top of the rail. Between the tracks at intervals of 40 ft. along the floor are two-way air cocks so arranged as to make it unnecessary to carry air hose across the track. The third and fourth bays are devoted chiefly to presses, shears, punches and other car repairing machinery, the location of which is shown in the drawing. Narrow gage tracks in this area serve a portion of the standard gage tracks and the machines. A toolroom is situated in the area in the forward end of the bays next to the west wall of the building. In addition to the six-ton crane the line of columns separating these bays carries runways for a collection of air-riveting machines. These runways are supported 6 ft. 3 in. from the columns on each side, 14 ft. above the floor, each serving five riveters, all of which are suspended from the runways by chain hoists.

The other three bays in the building are each 500 ft. long. In the west half of the fifth and sixth bays are four standard gage tracks arranged with a narrow gage track in the center of each bay. The east half of the area, except for the boiler plant at the far end, is occupied by four oil furnaces, a number of forges and additional machinery, chiefly presses and punches. Each of the fifth and sixth bays, like the others, has two six-ton cranes. In addition, jib cranes are installed on a number of the columns to serve the big presses and punches in the vicinity. The seventh bay of the building is occupied throughout by two standard and one narrow gage track, except for the extreme east end where the shop office is located.

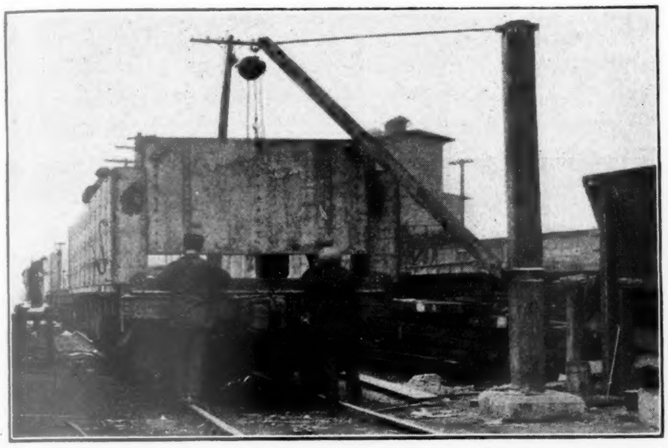
An important feature of the plant, aside from the large number of cranes, riveter runways and jib cranes, is the system of narrow gage track laid in the building. These tracks have already been described as extending between all standard gage tracks and throughout the machine areas. Their main value, however, rises from the fact that they form an integral part of a system which extends all over the yards and also from the installation of two lines of this track crossing the building at the center with switches to all longitudinal tracks. This affords a connection between all tracks in the shop and facilitates communication with the areas outside the building. By means of an adequate number of electric tractors and trailers the economical handling of material throughout the plant is thus assured.

Special facilities have been provided for the workmen including principally a modern wash and locker room which is built adjacent to the south side of the building on the outside. This building is built 28 ft. wide and 100 ft. long. The first floor is equipped with individual



Drawing showing the location of the machine tools and track layout

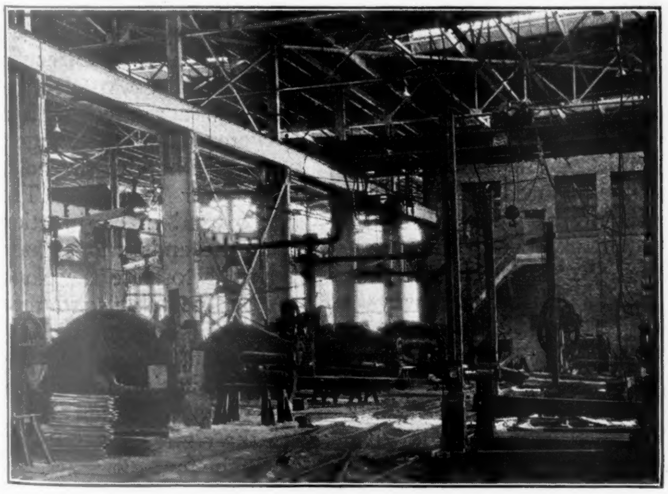
toilets and with washing facilities which include rows of double basins across the building in addition to basins along the wall, all of which are provided with spray faucets, while an upper floor is built for steel lockers and lunch room. There are 506 of these lockers, all installed on transverse tiers on concrete footings which serve also as seats. This building is well-lighted and ventilated and has concrete floors throughout. Two rows of drinking fountains extend through the main shop at intervals of about 120 ft. and three rows of urinals at intervals of 80 ft., the latter draining into sewer lines which also serve a collection of floor drains well distributed throughout the shop.



This jib crane located at a strategic point facilitates handling heavy end gates

Another adjunct of the building is an offset 10 ft. wide and 30 ft. long added to the north and one to the south wall of the shop for electric welding work, it being the practice to move only the acetylene outfits from point to point in the shop.

No heating facilities are provided except for the office and for washing purposes. The boilers for this purpose, together with other power equipment, including four modern electrically-driven compound air compressors and heating boiler, are enclosed in a room in the east end of the building. This room includes an overhead platform for the electric transformers and is supplemented by a room provided above the office for repairing all electrical equipment. The machinery installed at this shop is shown in one of the drawings.



Car shop interior—View looking northeast, showing battery of punches

Organization for building composite gondolas

During 1924, 929 steel cars were given light repairs and 2,191 heavy repairs at the Joliet steel car shop. The men employed on this work averaged 514, the supervisory force consisting of one general foreman and nine foremen. When it became necessary to rebuild a series of 100,000 lb., drop-end, composite gondolas, arrangements were made to fabricate the new steel parts required on these cars in the steel shop and apply the decking, heavy wooden sides and reinforced end gates by the progressive system on an outside track adjacent to the steel car shop.

The location of the machinery in the steel shop is scientifically planned to provide straight movement of the long, heavy steel plates, channels, angles and other structural steel shapes through the shop with a minimum of handling and absence of back travel. The raw material comes into the third and fourth bays from the east end where it is cut to size, punched on automatic spacing machines and passed on to the west ends of the bays where portable pneumatic riveters, supported by chain hoists from monorails, are used by special gangs in performing the various assembling and riveting operations. The furnaces and hydraulic presses, shown in the drawing, are used for manufacturing the great quantity of pressed steel shapes used in the different types of steel cars.

View showing riveting yokes and runway

In the composite gondolas under consideration, the steel work consists of built-up center, side and end sills, assembled, together with special reinforced end posts, to form a rugged steel frame for this car which must be strong enough to resist the severe service encountered in handling coal, steel billets, structural steel shapes and other heavy material from the mills. The organization for handling sill work consists of eight gangs, five gangs on center and side sills and three gangs on end sills. Each center and side sill gang, consisting of six car men, two car helpers, two rivet heaters and one car helper (supply), has a capacity to turn out nine center sills or ten side sills in an eight-hour day. Each end sill gang, consisting of three car men, one car helper and one rivet

heater, has a capacity of eight end sills in eight hours.

There are 24 assembling stations in the shop where 24 underframes are laid down. This work is divided into fitting frames and driving frames. The 12 frames which are laid down and fitted one day are driven and shipped the next. One fitting gang consists of five car men, and one driving gang consists of two car men, two car helpers and two rivet heaters. There are twelve of each of the above gangs required for the 24 stations which have an output of 12 finished underframes in eight hours.

When completed in the steel shop, the underframes with corner posts applied are loaded on flat cars and set on a track south of the shop. Here they are applied to trucks built up from new and reclaimed material which has been saved from the series of cars being rebuilt. The trucks and underframes then move to the track on which the wooden parts of the car are applied.

Station method used in applying wooden car parts

There are nine stations on a single track for the application of air brake equipment, deckings, sides, etc., and completing the car, two cars being worked on at the same time at each station. The gangs at each station are so organized and balanced that their work is completed at approximately the same time, and a move is made every 40 min., giving an output for the track of 12 cars a day.

At Station 1 the train line and air brake equipment are applied, two men working on the air cylinders and reservoirs and two other men applying the balance of this equipment. Stringers are also applied and nailed in place at this station by two gangs of four men each.

At Station 2 the riveting gang puts on all safety appliances, sill steps, grab irons, lift lever brackets and brake staff supports, the gang consisting of one car man, one helper and one rivet heater.

At Station 3 the couplers and side stakes are applied by a gang of eight car men.

At Station 4 the decking is applied by 12 car men.

Machine for boring holes in side plank and cutting them to length

At Station 5 the car sides are applied by one gang of eight car men.

At Station 6 the car sides are bolted in place by 16 car men.

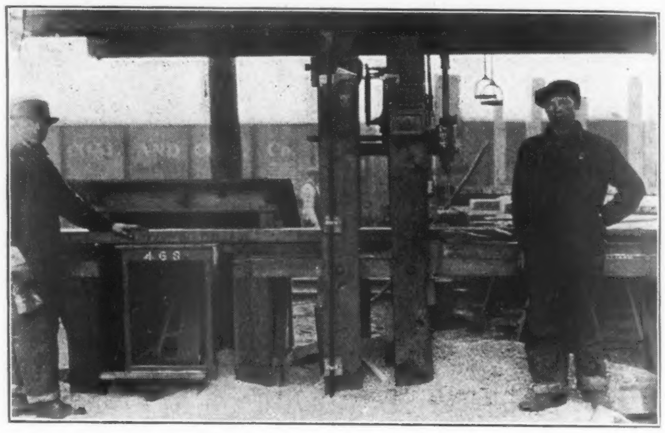
At Station 7 the end gates are made by six car men and applied by the same men who apply the car sides.

At Station 8 the decking is nailed by two men using pneumatic nailing machines.

At Station 9 the air brake is tested and the cars painted and stenciled.

The organization for handling the application of air brake equipment and wooden parts to these composite cars is notable for the smoothness with which it functions. Every effort is made to save unnecessary handling of material, and minimize the manual labor involved in that handling which is actually necessary. As a means to this end, woodworking machines, including cut-off saws, rip saws and boring machines, have been located as required at various points along the track with protection afforded against rainy and stormy weather.

For example, at Station 2 a special gang of five men handles and cuts off the 3-in. yellow pine decking; two men operate the rip saw for such pieces of decking as are not the right width; and two operate a boring machine,



Close-up view of machine for cutting off side planks

all of which are protected from the weather by means of a small shed. Several grooves must be cut the entire length of nine pieces of decking for each car to accommodate the nine tie rods which extend crosswise of the car. An ingenious arrangement, known as a "wabble" saw, enables this groove to be cut 1-in. wide by 7/8 in. deep, quickly and with only one pass over the machines.

The arrangement for machining and applying the 3-in. No. 1 Douglas fir side planks is exceptionally effective and clearly shown in two of the illustrations. An electric-driven, two-spindle boring machine is arranged with a table and rolls long enough to accommodate the longest plank and an automatic spacing device whereby the holes can be bored without measurement for location. The illustrations show a cut-off saw also used in conjunction with this boring machine to square the ends and cut the planks to length. The first operation is to slide the plank up the two inclined ways to the machine table, and then cut off one end of the plank enough to give a clean, square cut. The plank is then pushed along the rolls against a stop which gives the proper position for boring the first two holes. Subsequent holes are then bored rapidly as the plank is advanced to the right from position to position. At the final position, the cut-off saw cuts the plank to length, the plank then being slid on greased ways to a platform about three feet high between the machine and cars at Station 5.

An ingenious jib crane which assists in applying end gates is also shown in one of the illustrations. These gates are made by a gang of six men on a platform shown at the right in the illustration. The planks, cut to the right length, are shipped to this platform and the work consists of boring them with pneumatic drilling machines in accordance with holes in the steel sheets with which they are reinforced. The planks are then bolted in place and by means of the jib crane and differential chain

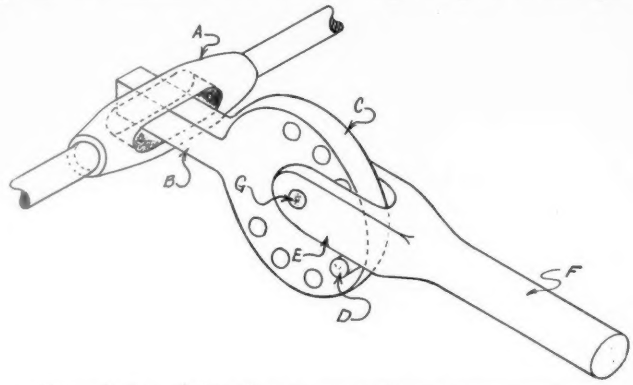
hoist illustrated, they are readily swung into place on the car. This gang of six men turns out 24 end gates in eight hours.

Aside from the new shop facilities at Joliet, careful attention to details in handling material and proper balancing of the gangs have been mostly responsible for the effective manner in which these E. J. & E. 100,000-lb. composite gondolas are being rebuilt.

Wrench for tightening turnbuckles

THE wrench shown in the drawing is used at the Waycross, Ga., shops of the Atlantic Coast Line for tightening turnbuckles on the truss rods of passenger cars, where equipment boxes, water tanks and other apparatus interfere with the free use of a straight bar.

The tongue, *B* is 1½ in. square and 7 in. long, forged in one piece with the 9-in. disc, *C*. The yoke *E* has sides ¾ in. by 3 in., with a depth of 6 in. The handle *F* is 1¾ in. in diameter and 10 in. long, forged in one piece



Wrench for tightening truss rods on passenger cars

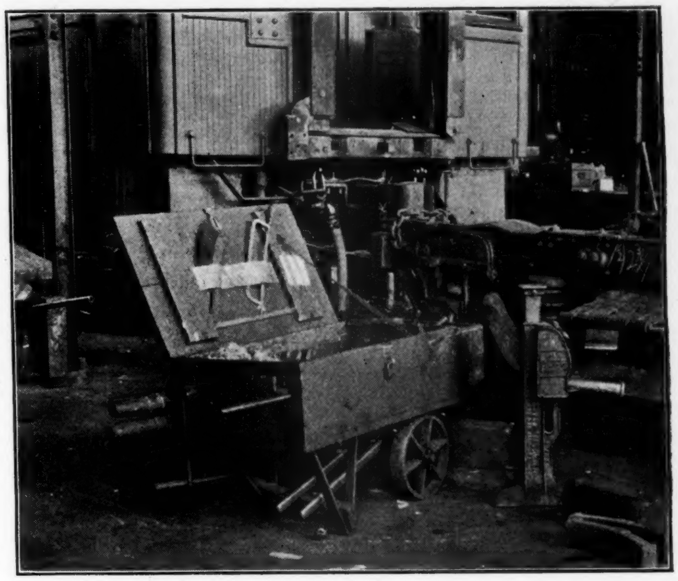
with the yoke. A piece of 2-in. pipe may be used for an extension to this handle when desired.

The disc is drilled at the center and fastened to the yoke with a 1-in. pin, *G*. Eight 1 1/16-in. holes are drilled in the disc as shown. A 1-in. pin, *D,* is inserted in a hole either above or below the yoke according to the direction the turnbuckle is to be turned. This provides a rigid wrench with the handle at a convenient angle so that a man may operate it to the best advantage. The description of this wrench was obtained through the courtesy of the Atlantic Coast Line News.

Car repairmen's portable tool box

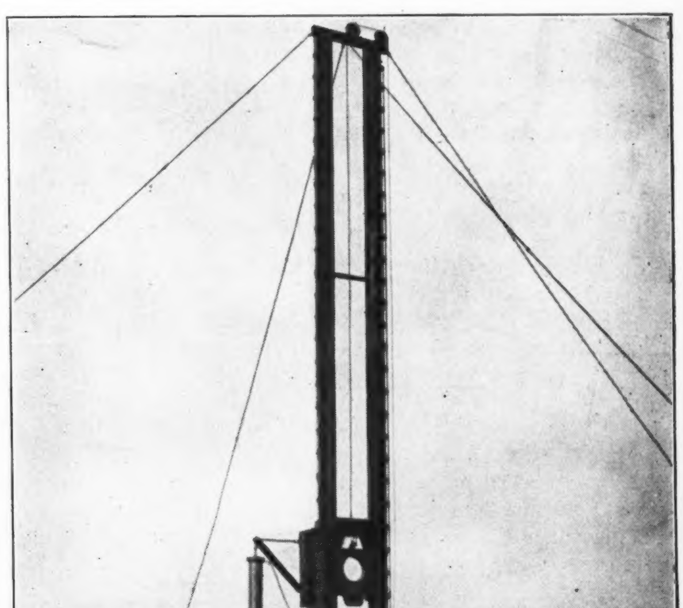
IN some car shops it is the practice for the workmen to keep their tools in a bench drawer or locker. This means that every morning the workmen have to get their tools out and carry them to the job and in the evening gather them up and put them away for the night. Thus, considerable time is lost before the men are ready to start work, to say nothing of tools becoming lost or stolen, owing to the fact that the tools are scattered all around the car on which they are working.

This condition is particularly true where the work is specialized and one gang goes all over the shop, i.e., a truck gang. The tool wagon shown in the illustration is used by a truck gang in a passenger car repair shop. The wagon is fully equipped to repair trucks. The main box contains the larger and most valuable tools. At the front end is attached a small box in which are kept drifts, chisels and other odds and ends used on the job. Two large wooden jack handles are carried on the side of the box in two leather straps. Beneath the box are carried large single end wrenches. Two Duff jacks are carried in the box. The handles of the wagon are so constructed that when they are not in use, they hang out of the way

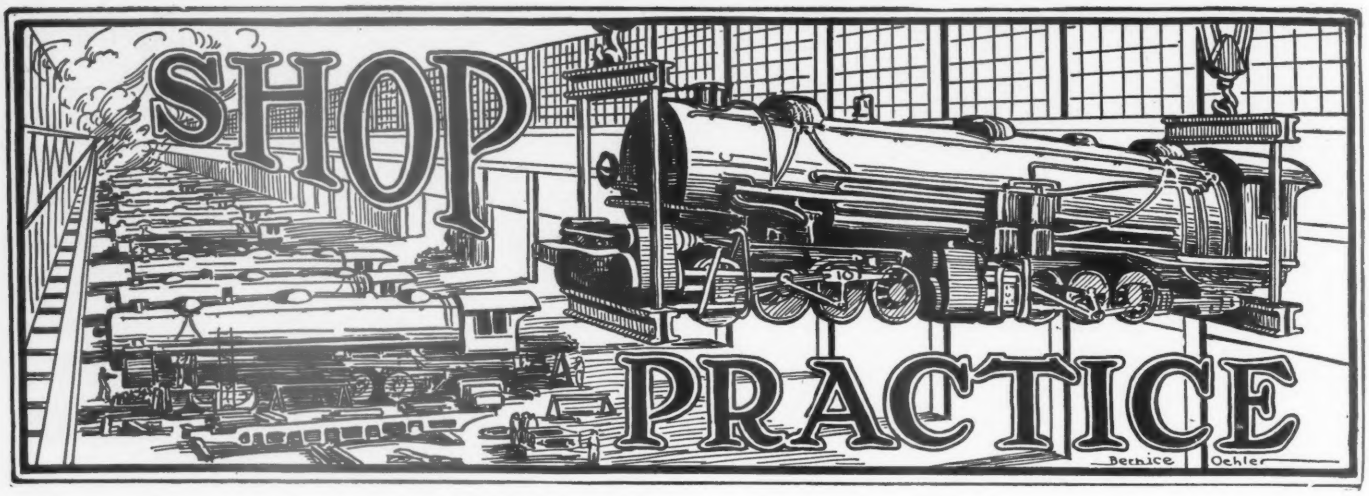


Portable tool box used by a car truck repair gang

perpendicular to the floor. At the end of the day, the tools can be quickly gathered up and placed in the box which is locked and left standing by the job until the next morning.



Drop test machine presented in 1900 to Purdue University by the Master Car Builders' Association



Inspection of flexible staybolts*

By E. S. Fitz Simmons
Sales Manager, Flannery Bolt Company, Pittsburgh, Pa.

THE development of the flexible staybolt, in this country, dates back to about 1890 and early experimentation was stimulated by the enormous number of breakages which occurred in the rigid type of staybolt. Probably the first type of flexible staybolt which could be readily inspected without removal was one of the round headed design, using a sleeve and removable cap, which was designed by John B. Tate of the Pennsylvania Railroad and introduced by the Flannery Bolt Company about 1904. This design gave promise of eliminating many of the weaknesses of former types and provided a means, though an expensive one, of ascertaining the condition of the bolt without removing it from the boiler. For these reasons it was quite generally tried out by many railroads and the results obtained were so satisfactory that its adoption and general use almost immediately followed.

In 1905 a Committee of the American Railway Asociation reporting on flexible staybolts said of it: "Though of comparatively recent date, it has been received with great favor, indicating the rapidity with which a new bolt of promising design is given a practical trial in the effort to cure the staybolt trouble." Further in this same report the committee stated the following: "A simple means of positively detecting cracked and broken bolts is an improvement needed by all flexible bolts that are in service at the present time. The removable of the cap, which will allow an examination of the bolt, is the only absolute means possible with flexible bolts of the present design."

In 1911 the act commonly known as the Locomotive Boiler Inspection Law became effective, under authority of which, rules requiring among other things the removal of caps from flexible staybolts for inspection purposes at special stated intervals, were promulgated and enforced.

The generally satisfactory service rendered and the very small percentage of breakage to total number in service (this type having become practically standard) created a doubt in the minds of many railroad mechanical officers of the justification of such a rule or requirement and it was quite generally, and for a time quite strenuously, opposed. However, the Locomotive Inspection Bureau, through its corps of inspectors, had indisputable evidence of the necessity for thorough and regular inspection, for while it was admitted that the percentage of breakage to the total number in service was small, it was shown beyond question of doubt that in certain instances breakage did occur to such an extent as to become a menace to life and property.

Investigations were begun to determine the cause of breakage in an endeavor to apply a remedy. A number of investigations confirmed the absolute necessity for careful and frequent inspections and also clearly demonstrated the need of a more accurate and positive method of test than the mere removal of the caps and an examination of the bolt heads.

Instances were found where, under bad water conditions, accumulations of scale between the body of the bolt and the inner wall of the sleeve were such as to solidly lock the bolt in the sleeve. The result was to render ineffectual the flexible feature and to cause the bolt to break at the fire box sheet.

During the past ten years, and more diligently during the past five years, after these abnormal conditions had been prominently developed, constant effort has been made to perfect a method of inspection that would provide greater safety and insure against loss of life, injury to persons, and damage to property.

The first actual service test of such a method was made in August 1920 on large Mallet type locomotives where abnormal conditions existed and where breakage of flexible bolts was excessive. This method consisted of the installation of flexible bolts with telltale holes extending from the firebox end entirely through the body section and terminating within the bolt head, and the testing of these bolts at regular intervals with a specially constructed instrument to determine definitely that the telltale holes were open and, therefore, operative throughout their entire length. This was accomplished by so constructing the instrument that an electrical circuit would be established when contact was made at the end of telltale hole.

During this service test, two distinct features were developed:

*Abstract of a paper presented at a meeting of the Southern Railway Club, Atlanta, Ga., September 17, 1925.

First—that moisture, due to temperature changes, condensed in the telltale hole and formed rust or iron oxide which gradually increased to such an extent as to interfere with the insertion of the testing instrument. In seeking a remedy for this condition, various methods were tried, the most satisfactory and the one at present in use being the electro-plating of the walls of the telltale hole with copper. Four years experimental work and service tests have demonstrated the complete success of eliminating the difficulty by this method.

Second—that cinder and other foreign matter accumulated in the telltale holes to such an extent as to require excessive labor to dislodge and remove it in order to permit the insertion of the testing instrument. The cost and time required for this made the method impractical. After numerous experiments it was found that a closure of fire-proof porous material applied in the end of the telltal hole prevented the accumulation and at the same time permitted leakage of steam or water in case of fracture, and that it was also readily and cheaply removable to allow insertion of the testing instrument.

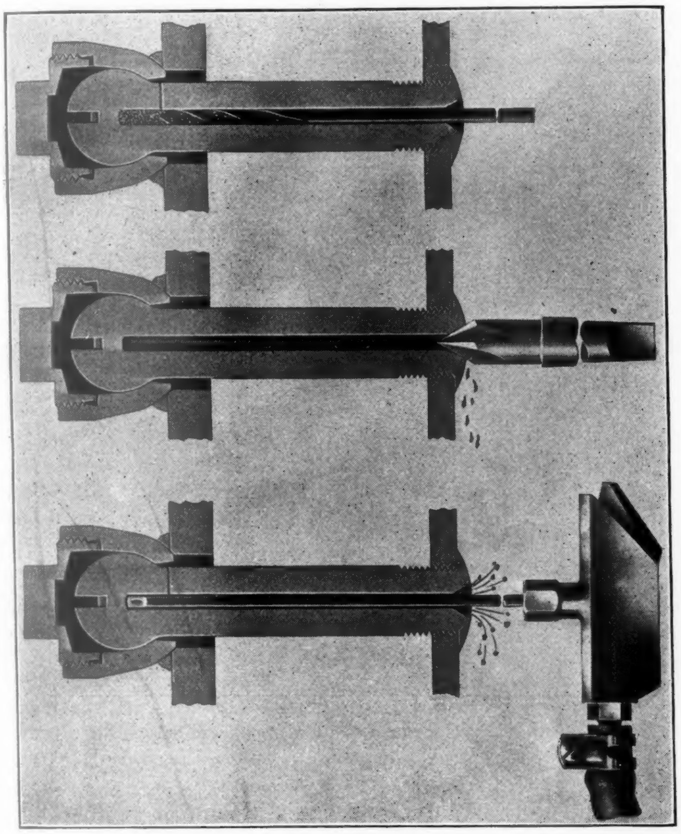


Fig. 1—Cleaning out the telltale hole by means of special air tool

Application of telltale flexible staybolts

The telltale flexible bolt is identically the same as the Tate bolt with the addition of a telltale hole extending through the entire length of the body section and terminating within the head of the bolt. The walls of the telltale hole are copper plated to prevent rust or corrosion within the hole and to prevent them from becoming closed from this cause.

They are applied exactly the same as the ordinary flexible bolt. If the method of riveting closes the end of the hole, it may easily and quickly be re-opened, after which a porous fireproof closure is applied that will prevent the accumulation of foreign matter from entering the telltale hole and that will permit leakage of steam or water in case of a break or fracture, which serves as a daily indicator of the condition of the bolt.

Inspection of telltale flexible staybolts

In addition to depending on the leakage through the telltale hole, an inexpensive method of periodically checking up the condition of the telltale hole is provided as follows:

The fireproof porous closure is first removed, after which the specially constructed testing instrument is inserted. Upon reaching the extreme end of the telltale hole and making contact therewith, a light flashes in the handle of the tester indicating that the hole is open and therefore operative throughout its entire length.

The method of testing has been built upon the fact that a broken bolt having a telltale hole will show leakage of water or steam, providing the telltale hole is open and operative and that it extends to every breakable part of the bolt.

The tester is so designed and constructed that it will positively indicate whether or not the telltale holes are open throughout their entire length. After inserting the tester in each telltale hole and securing light in the handle (which indicates that contact has been made with the extreme inner end of the hole) if the bolt is broken, or fractured into the hole, leakage will positively occur when water pressure is applied to the boiler.

Use of the tester

First, with a sharp pointed pin or punch and a light hammer, break through the porous closure; then blow all of the remaining particles out of the telltale hole with the air tool—shown in Fig. 1. Attach the ground connection in any convenient telltale hole, then insert the tester rod into each telltale hole until contact with the end of each hole is secured. Such contact is indicated by the lighting of the bulb in the tester handle, as shown in Fig. 2. After contact has been secured in every bolt, apply water pressure to the boiler and every defective bolt will be indicated by leakage through the telltale hole. If no defective bolts are found, or after replacing any that are found, again close the telltale hole with the fireproof porous material and the locomotive is ready for service.

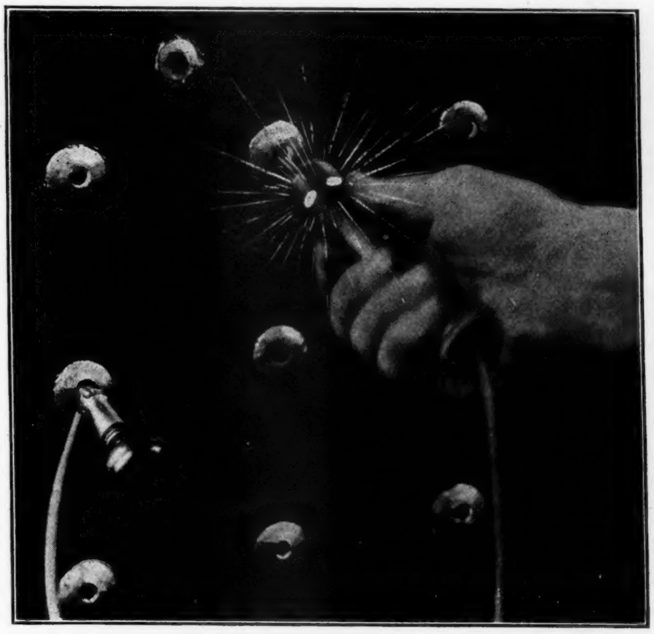


Fig. 2—A light in the tester handle indicates that the telltale hole is open the full length

Cases may occur where breakage or fracture will be

indicated by leakage and will not be observed or detected at the time they develop, as for instance bolts in locomotives in pusher service at isolated points or bolts located behind brick arches, grate bars, etc, and in which the telltale hole will gradually become filled by accumulation of scale from the boiler water. Therefore, whenever the tester is inserted, it strikes an obstruction and fails to show a light in the handle, as is shown in Fig. 3. In such cases the tester should be removed and a special cleaning drill applied to remove the obstruction. After drilling, blow clean with the air tool such as was shown in Fig. 1, re-insert the tester, and if the hole has been thoroughly cleaned, contact will be secured and indicated by the lighting of the bulb as before described and when water pressure is applied, leakage will occur.

Bear in mind that securing contact in the telltale hole does not indicate that the bolt is in good condition, but only that the telltale hole is open and operative throughout its entire length. It is the failure of the bolt to leak under pressure after contact has been obtained which indicates that it is not broken.

The present method of inspection requires from three to four or more days, the principal part of the work being the removal and replacement of parts, rather than the actual time required by the inspector to examine the bolts.

By the new method herein described, it is not necessary to touch or remove anything on the outside of the boiler and the entire test on a modern locomotive boiler containing a full installation of flexible bolts can be completed within an eight-hour day—and at a labor cost of from \$10 to \$20, depending on the size of each respective installation.

The cost to strip, remove caps, inspect, and replace runs

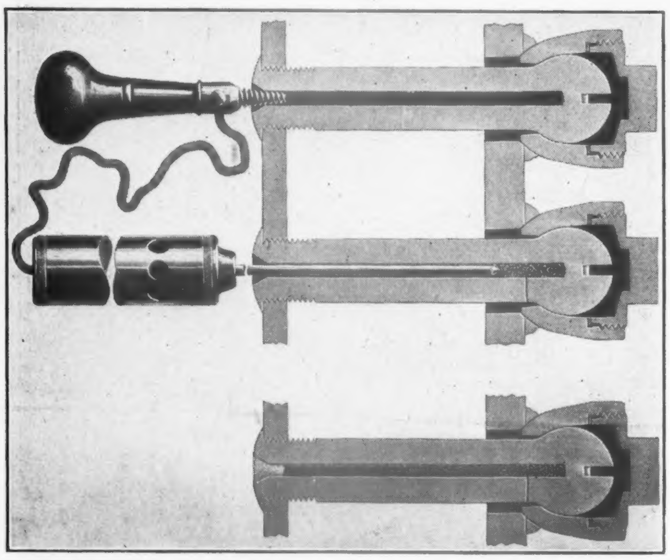


Fig. 3—An obstruction in the telltale hole prevents the tester rod from making contact. This condition is indicated by the failure of test lamp to light

from \$100 to \$250, depending upon the size of the locomotive and upon the facilities at hand, and in addition, results in two, three, and sometimes more, days loss of engine service.

The principal advantages of the new method of inspection are: Greater safety by constant daily indication of bolt conditions; material reduction in maintenance costs by reason of eliminating a vast amount of labor now required under the older method of inspection, and a substantial saving in locomotive service by reason of being able to make inspection by the new method at the time of the regular annual hydrostatic test and without additional loss of locomotive service.

A number of railroads have been using the new method of inspection just described for some time, irrespective of the fact that the Government had not yet approved it, because they were convinced that it added such an immeasurably increased factor of safety that it would more than compensate for the additional cost of this method of testing in addition to complying with the Interstate Commerce Commission rules that require the removal of caps every two years. The Locomotion Inspection Bureau, however, has been fully aware of the use of this new method for the last four or five years, has been checking

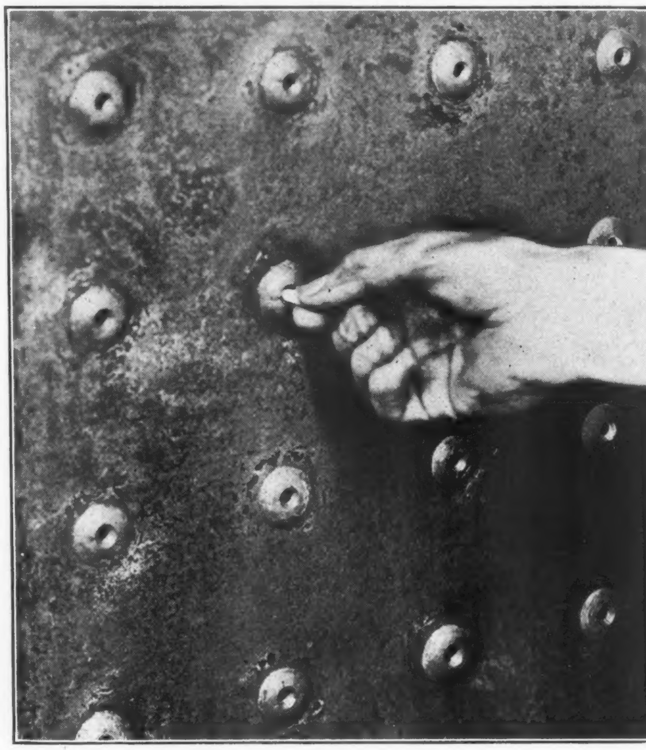


Fig. 4—Applying the porous closure to telltale hole after inspection

up the results carefully, and when a number of the railroads that have been using this method of inspection for some time made an application for a modification of Rule 23, careful consideration was given with the result that, at a general session of the Interstate Commerce Commission held at its office in Washington on July 26, 1925, it was ordered that Rule 23, as approved in the order of the Commission entered April 7, 1919, be, and the same is hereby amended to read as follows:

23. *Method of testing flexible staybolts with caps.*

Except as provided in paragraph (b), all staybolts having caps over the outer ends shall have the caps removed at least once every two years and the bolts and sleeves examined for breakage. Each time the hydrostatic test is applied, the hammer test required by rules 21 and 22 shall be made while the boiler is under hydrostatic pressure not less than the allowed working pressure.

(b) When all flexible staybolts with which any boiler is equipped are provided with a telltale hole not less than 3/16 in. nor more than 7/32 in. in diameter, extending the entire length of the bolt and into the head not less than one-third of its diameter and these holes are protected from becoming closed by rust and corrosion by copper plating or other approved method, and are opened and tested, each time the hydrostatic test is applied, with an electrical or other instrument approved by the Bureau of Locomotive Inspection, that will positively indicate when the telltale holes are open their entire length, the caps will not be required to be removed. When this test is completed, the hydrostatic test must be applied and all staybolts removed which show leakage through the telltale holes.

The inner ends of the telltale holes must be kept closed with a fireproof porous material that will exclude foreign matter and permit leakage of steam or water, if the bolt is broken or fractured, into the telltale hole. When this test is completed, the ends of the telltale holes shall be closed with material of different color than that removed and a record kept of colors used.

(c) The removal of flexible staybolt caps and other tests shall be reported on the report of inspection Form No. 3, and a proper record kept in the office of the railroad company of the inspections and tests made.

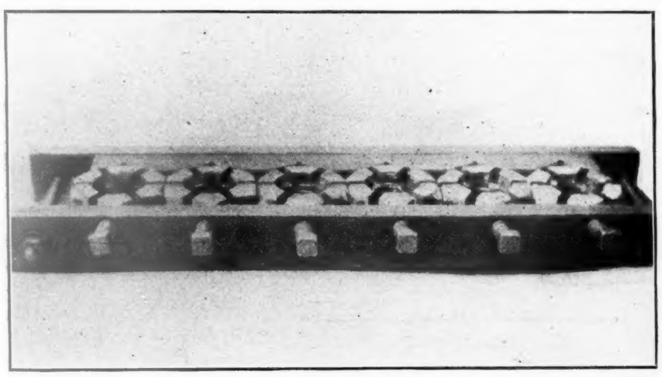
(d) Fire box sheets must be carefully examined at least once every month for mud burn, bulging, and broken staybolts.

(e) Staybolt caps shall be removed or any of the above tests made whenever the United States inspector or the railroad company's inspector considers it desirable in order to thoroughly determine the condition of staybolts or staybolt sleeves.

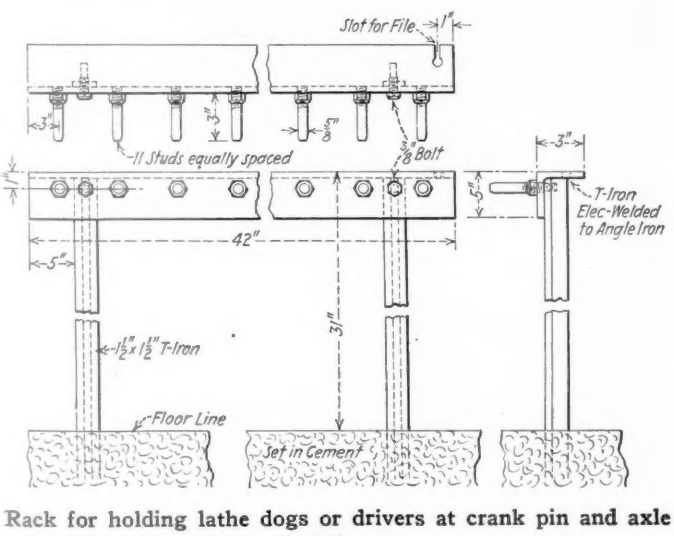
Effective shop jigs and devices

American Railway Tool Foremen's committee report on the subject calls attention to many shop devices of value

ONE of the features of the American Railway Tool Foremen's convention, held at Chicago, September 2 to 4, was the report on jigs and devices for locomotive and car shops, read by Chairman Henry Otto, tool foreman of the Atchison, Topeka & Santa Fe at Topeka, Kan. An imposing aggregation of photographs and blue prints of labor-saving shop devices were distributed for the examination of members of the association and posted around the walls of the convention hall. Some of these have already been described in previous issues of the *Railway Mechanical Engineer* and a selected list of eight others are illustrated in the following article. As mentioned on the floor of the convention the committee expressed its appreciation for help in collecting data and photographs of many of the shop kinks to J. R. Phelps, shop apprentice instructor of the Atchison, Topeka & Santa Fe at San Bernardino, Cal.

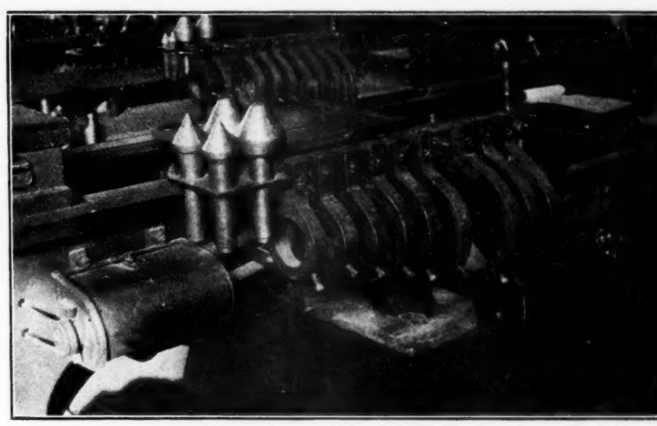


Jig used in cutting slots for castle nuts



Rack for holding lathe dogs or drivers at crank pin and axle lathe

Cutting slots in castle nuts—The illustration shows a device for cutting slots in castle nuts of sizes that are not carried in regular stock. The device is easily made of a scrap driving box shoe in which a strip is placed on one side, machined to fit the corners of six or more nuts and provided with a corresponding number of set screws on the other side to hold the nuts tightly in the jig while slots are being cut. The set screws are pointed downward at an angle of 5 deg. to offset any tendency of the nuts to work up under the action of the milling cutter. By having the machine operator turn the nuts as fast as they pass under the cutter, when one complete cut has been finished everything is in readiness for the next cut and there is no lost time in setting up. It will be noted that the sides of the shoe are tied together by two 5/8-in. bolts to give the jig added rigidity and prevent either side of the shoe breaking off, as might happen particularly if made of cast iron.

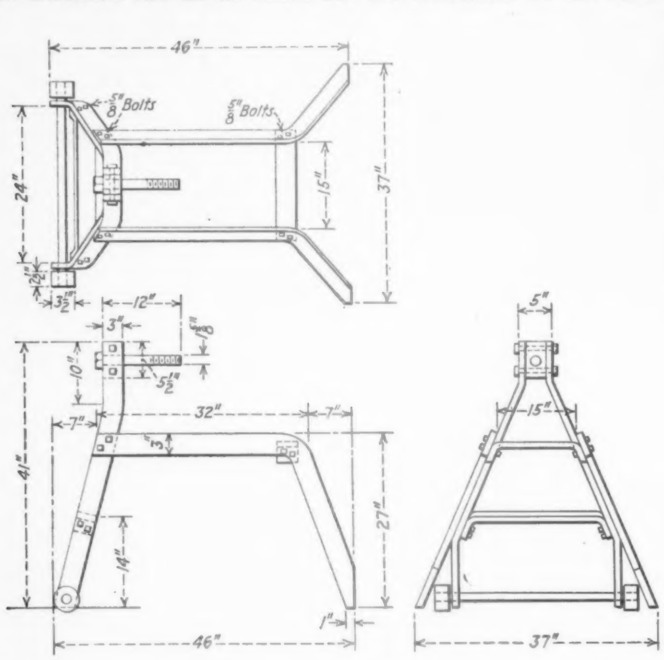


Rack for lathe dogs and centers

Rack for holding lathe dogs—Two racks for holding lathe dogs and lathe centers are illustrated. It will be readily seen that by the use of these racks the lathe dogs or drivers are kept off the floor and out of the way, at the same time being within convenient reach of the lathe operator when needed. There is less liability of the dogs being lost or damaged and, moreover, this arrangement favors the sweeper who does not have to move them about

from one place to another in attempting to sweep the floor.

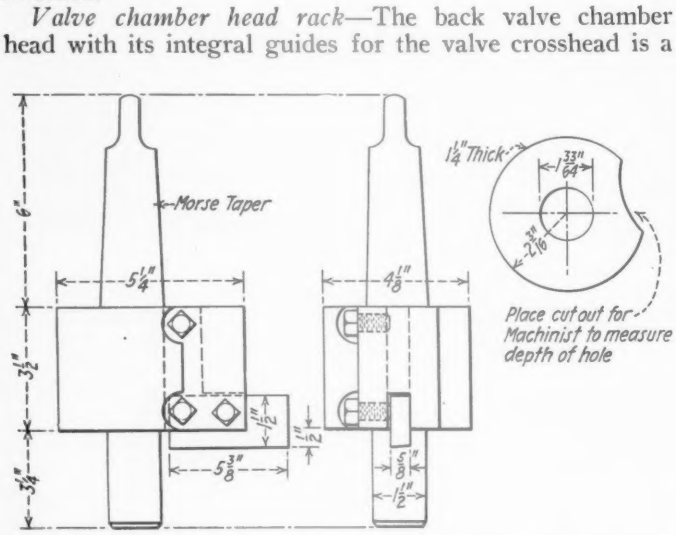
These racks are also used for holding lathe centers. One of the most important things about a lathe is its centers and by keeping the extra centers out in plain view, as illustrated, they are not so likely to be damaged as would be the case if thrown in a drawer with other tools or possibly left on the floor. Moreover, the machinist or foreman can at all times see the condition of the lathe



Rack for holding back chamber head while being worked on

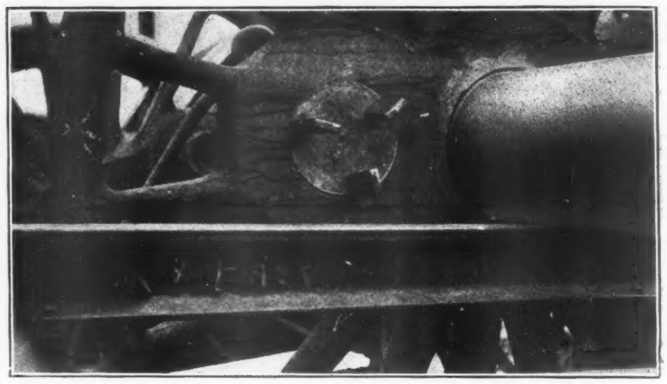
centers and this arrangement eliminates any possibility of the last extra lathe center being damaged and causing delay to an important job while it is being annealed and re-trued.

Valve chamber head rack—The back valve chamber head with its integral guides for the valve crosshead is a



Tool for facing the stuffing box of back valve chamber heads

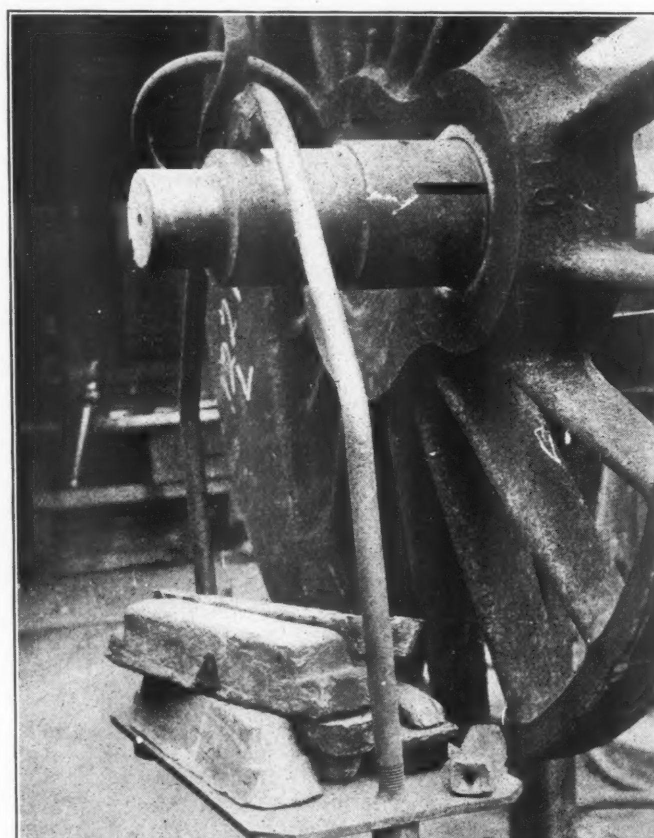
complicated casting of considerable weight which is extremely awkward to handle at the bench. A simple but convenient rack for holding any size of back valve chamber head while being worked on, is illustrated. This rack consists of a built-up framework of 1-in. by 3-in. bar iron bolted together and supporting at the top a horizontal holding bolt, 1⅝ in. by 10 in., to be inserted in the stuffing box hole in the valve chamber head. By means of suitable washers and a nut the head can be drawn up against the framework and held firmly at any angle required for the most convenient performance of the particular job at hand. The distance of the horizontal holding bolt above the floor is such as to bring the back head at approximately bench height. It will be noted that two legs of the rack are provided with small wheels so that by



Three taper keys hold temporary crank pin in place

lifting the other two legs one man can readily move the rack across the shop floor and yet it will not move too easily while work is in progress on the valve chamber head as long as all four legs are on the floor. Back valve chamber head work can be performed better, easier, and in less time by the use of this rack.

Facing stuffing box holes—A tool for facing the stuf-

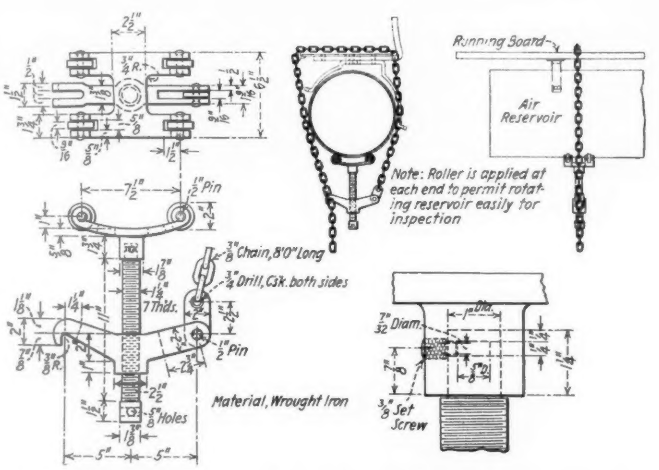


Temporary crank pin for use in quartering driving wheels

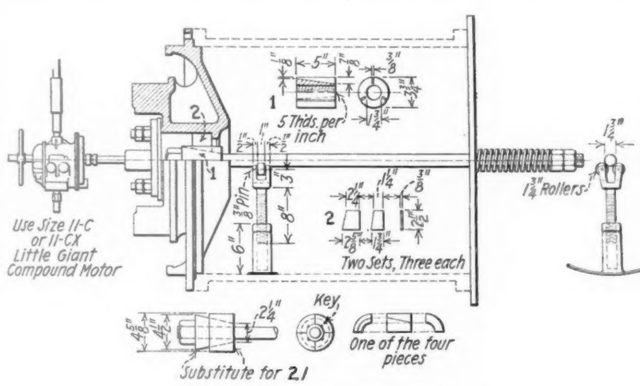
fing box holes in back valve chamber heads is shown in one of the drawings. Formerly this job had to be done on a horizontal boring bar often over-crowded with other work. With the tools shown, the facing operation can be performed complete on any heavy duty drill press, the

drilling, boring and facing operations all being done at one set-up of the back valve chamber head. The amount of metal to be removed and the width of the cut make it necessary that the pilot of the tool be guided by the block shown. The pilot is turned to 4⅜ in. in diameter so that it just fits in the bore of the stuffing box. The segment cut out is to enable the machinist to measure to the bottom of the hole and face off the stuffing box enough to secure the proper depth.

Temporary crank pins—A good start is often gained in fitting up a pair of new main driving wheels if the wheels can be weighed and counterbalanced and this work finished before the crank pins are made and pressed in. The illustrations show an arrangement whereby temporary crank pins with crank arms (if any) can be quickly applied and used in counterbalancing. Three tapered key-ways are milled or planed in each of a pair of scrap crank pins taken from the same class of locomotive as the one for which the new wheels are being made. These key-ways are ⅝ in. wide and take tapered keys 19/32 in. thick by 9 in. long and having a taper corresponding to that in the crank pin. A taper of 1⅛ in. in 12-in. has been found to give good results.



Rollers for testing main air reservoirs on locomotives



Cylinder head supporter

The temporary crank pins are an advantage in practice when a pair of driving wheels is due to be weighed and for some reason the main pins are not ready; or possibly the tires must be put on and then after the crank pins are finally applied and the wheels put on the weighing rack with the proper weights hung on the pins, it develops that the tires must be taken off again to get the necessary lead into or out of the counterweight pocket. This is very likely to happen on an engine that has not been previously weighed and brought up to standard. With the temporary crank pin arrangement the wheels can be weighed and the tires put on to stay, whether the main crank pins are ready or not. Key-ways should be cut in two old scrap pins for each class of engine on which much weighing is done. The eccentric crank should be in position when the weighing is done; it being left off in the illustration in order to give a clearer picture.

Main reservoir rollers—A convenient arrangement for use when testing main air reservoirs on locomotives is shown in one of the drawings. The particular advantage of this device is that it enables the reservoir to be thoroughly tested without taking it down from the locomotive. The principle of operation is evident from the drawing, a chain and bracket with four rollers, rolls simply being applied around the running board and under each end of the reservoir. All pipe connections are broken and the reservoir clamps loosened. By tightening the screw underneath the rollers the weight of the reservoir is taken off the clamps and is supported on the rollers. The reservoir can then be revolved slowly for the hammer test with the assurance that every part of it will be thoroughly examined and tested.

Cylinder head supporter—The necessity of grinding back cylinder heads to a joint on the cylinders is generally admitted and as these heads carry the guide blocks and are heavy, the supporter shown in the illustration will be found useful in taking the weight off the cylinder counterbore and permitting the cylinder head to turn more easily. The supporter consists simply of a pair of 1¾-in. rollers set one at each end of a forked rod threaded into a sleeve and provided with a lock nut. The tension of the cylinder head against the cylinder is adjusted by means of the spiral spring and nut on the end of the center rod. A compound pneumatic motor is used to revolve the cylinder head during the grinding operation.

Drawbars and pins*

By James T. McSweeney,
Master blacksmith, Baltimore & Ohio, Garrett, Ind.

ON the Baltimore & Ohio drawbars and pins are made of steel billets or rolled steel bar at a workable heat. The holes are drilled in the ends. By this method we get a better bearing on the pins. If there is to be an oblong hole in the drawbar ends, such holes are slotted and not cut out with torch. The purpose of having an oblong hole in the drawbar is to relieve the shock on the pin when coupling on to a train.

No holes in the drawbars are required. When the holes are found to be worn to ¼ in. diameter larger than the original size, the bar is scrapped and the material is used for some other purpose. Drawbars and pins are removed and carefully examined every three months for possible defects. When the locomotives are undergoing classified repairs, the drawbars are removed and heated to a cherry red, given a thorough examination for defects while hot and are then allowed to cool slowly in a dry place, free from dampness or drafts. The welding of drawbars either in the blacksmith shop or by the autogenous method is not permitted.

Drawbar pins are made from rolled steel bar stock and used without turning. In my experience I find that pins made from bar stock and not turned, give the best wear. If the pins are turned, they should be annealed before being placed in service. This makes the pin tougher and it will withstand wear longer.

*Abstract of paper presented at the twenty-ninth annual convention of the International Railroad Master Blacksmith's Association, Cleveland, Ohio, August 18-20, 1925.

The importance of the toolroom to the railroads*

Some ways in which it can be operated to help reduce shop and enginehouse costs

By E. L. Woodward
Western Editor, Railway Mechanical Engineer

THE importance and necessity of an efficiently organized toolroom in any railroad shop or enginehouse where a real attempt is being made to cut costs is self evident. The toolroom began to be an important factor in transportation with the first locomotive which was built. It is said that in 1829, before going ahead with his plans for the construction of the Rocket, George Stephenson was compelled to make a small, hand-operated engine lathe with which to fashion some of the locomotive parts. Presumably he also made the tools used in connection with the engine lathe and therefore fulfilled all three functions of locomotive designer, builder, and toolmaker. Since 1829 the toolroom has developed and now plays its full part as one of the vital departments of every railroad shop and enginehouse of consequence in the country. It may well be likened to the heart of the locomotive or car repair shop for from it flow the tools without which no other shop department can operate efficiently.

The motto of the American Railway Tool Foremen's Association, "For Greater Efficiency in the Railway Tool Service," is most happily selected, particularly the word service. It is not only the function of the tool foreman and his organization to provide necessary tools required for the various operations in repairing cars and locomotives, but it is doubly important that these tools be provided *when* needed, *where* needed, and in good working condition. In other words, the main object of the toolroom should be to provide real tool service to help eliminate as far as possible every lost moment, unnecessary step, and ineffective movement of the mechanics, repair men, helpers, and other employees in railroad shops and enginehouses.

There never was a time when this improved quality of tool service was more needed than at present. In June, 1925, 518,003 men were employed on maintenance of equipment work and receiving a compensation of $66,-228,792. The money which can be saved or wasted depending upon the kind of tools furnished these men can be readily appreciated. This is the opportunity, as well as the responsibility, of railway tool foremen.

There are many essentials to the provision of adequate tool service but these can probably almost all be summed up under one of the three heads (1) effective personnel organization, (2) up-to-date methods of handling the work and (3) toolroom equipment to meet modern needs.

System tool organization needed

As in all shop departments, the most important problem connected with toolrooms is one of supervision. Unquestionably those roads which have created the position of general supervisor of tools, and appointed a competent tool foreman to perform the duties of this position for the entire system have found the investment profitable. A railroad makes or saves money as a unit. Locomotives and cars are standardized for the system as are also shop practices to a considerable extent. Railway tools and toolroom practices must also be standardized for the system, for maximum economy, and practically the only way the managements can be sure of accomplishing this is by appointing an experienced man to devote his whole time to the work of general supervision. If some roads are too small to warrant the appointment of a general supervisor of tools some method must be devolved of co-ordinating the ideas of the respective tool foremen at individual points, otherwise there will be as many different types of special and commercial tools ordered and used as there are foremen. Some of these tools will be less efficient than others and an excessive number of repair parts must be carried in stock to keep them in operation.

Next to a general tool supervisor who can develop system standards of railway tools and toolroom methods, experienced local foremen and toolroom employees are required, for upon the accuracy and skill of their work depends in large measure the efficiency of the shop or enginehouse at which they are located. It is hardly necessary to point out to the members of this association the advisability of attracting to the toolroom as capable men as possible, training and developing them, and making their working conditions as attractive as possible in order that they may stay on the job and not necessitate the frequent breaking in of new men. The question of wages and general working conditions is not for the tool foreman to decide but it is in his power to make his men like their jobs or, on the other hand, begrudge every hour they have to spend in the toolroom.

The tool foreman has a wonderful opportunity to increase the efficiency of tool service by studying his men, taking a tactful interest in their personal problems, and in common with all other railway supervisory officers combating the campaign of criticism against the railroads and the tendency (probably less common now than it was three years ago) of doing as little work as possible for a day's pay. It may not always be easy for a foreman to meet the arguments of a glib-tongued fellow who spreads insidious propaganda with little regard for the truth. It is up to the foreman, however, to look up the facts and refute the man's arguments, otherwise he will lose standing with his own men and be negligent in duty to the railroad which employs him and on whose success and prosperity his own livelihood depends.

The tool foreman should help his men increase their knowledge of tools and tool making and in particular lend encouragement and assistance to any apprentice boys who may show special aptitude for tool room work. In connection with educational work the tool foreman should not neglect the opportunity to attend conventions like the present one of the American Railway Tool Foremen's Association. He should begin his campaign for permis-

*Address before American Railway Tool Foremen's Association at Chicago, September 4, 1925.

sion to attend these conventions early enough in the preceding year to insure success and wherever possible bring one or two or more of his leading workmen with him. They will all be benefited in direct proportion as they help in the preparation of papers, participate in discussion and above all take home and put into practice some of the ideas here developed. The advisability of reading all possible books and literature on tool making subjects need hardly be emphasized and the next best thing to attending the conventions is to read the record of the proceedings published in the *Railway Mechanical Engineer* and other technical papers which report the meetings.

Method of organizing the work

Space and time limitations prevent more than a mere outline in this paper of toolroom methods which have proved effective on various roads. As may be inferred from previous paragraphs, one of the greatest possibilities of economy on a railroad system as a whole is by the adoption of standard tools best suited to the needs of the individual roads. These tools should be limited to as few kinds and sizes as consistent, in order to minimize the number of repair parts which must be carried in stock and reduce the possibility of delay due to specific repair parts not being in stock. Standard instructions covering the kind of commercial tools to be ordered and the methods recommended for making those of special design in railroad toolrooms, have been compiled in the form of tool folios by several roads and promise to be real cost reducers through reduction of initial tool cost, cost of tool maintenance and by providing more efficient tools to the various shop departments.

Standardization is the keynote of economy in the toolroom. With system standardization, many of the special tools which railroads must make for themselves are used in such quantities as to justify the organization of a central manufacturing tool department, equipped with modern machines to turn out those tools at greatly reduced cost. The saving in cost of making the tools, however, is insignificant compared to the reduced cost of performing shop and enginehouse work with tools which are properly designed, made of the right kind of material and turned out with the proper inspection and supervision over each operation.

The question of how large a road must be to make a centralized manufacturing toolroom profitable is not easy to decide. Doubtless there should be many more toolrooms of this type than now exist.

What toolroom equipment is required

An able discussion of the types of machines needed in the large manufacturing toolroom, medium size maintenance toolroom and smaller toolrooms at outlying points has been presented at this convention by C. A. Shaffer, supervisor of shop machinery and tools of the Illinois Central. It may be well, however, to emphasize the importance of the screw machine or turret lathe for working up bar stock in the manufacturing toolroom, the punch press for stamping out gages in a fraction of the time required by hand, an automatic gear cutting machine where gears are cut in the toolroom, adequate milling machines of the plain and universal types and a full complement of grinding machines of ample size to handle the work and equipped where necessary with magnetic chucks.

The amount and kind of heat treating equipment will bear close investigation. An instance happened not many months ago in which a milling cutter worth upwards of $200 was absolutely ruined through the attempt to heat treat it in a furnace of insufficient capacity. It wouldn't take the loss of many such milling cutters to equal the price of a new furnace.

In conclusion, it may not be amiss to suggest that the tool supervisor or foreman, having perfected his organization, trained his men and standardized tool requirements, make an intensive study of his present toolroom machinery and equipment with a view to determining what could be accomplished with machines of more modern type. If savings can be effected show the "old man" the actual figures. If he has a grouch the first day you submit the figures, try him the next day from a new angle. He will think more of a man who, after forming his opinion, sticks to it. Whatever you do, never let him forget that the toolroom, as supervised by the efficient tool foreman, is the heart center of his entire shop and an important factor in railroad operation.

Portable cylinder saddle milling machine

By L. V. Mallory

Machine shop foreman, Missouri Pacific, Kansas City, Mo.

REALIZING the time and labor expended in most locomotive repair shops in fitting locomotive cylinder saddles to the boiler, the author has designed a simple, portable, milling machine which can be built at small cost, compared with the saving derived from its use in fitting saddles.

The vertical supports *A*, Fig. 2, which may be made either of 3¼-in. steel shafting or 2¼-in. by 3¼-in. steel tubing, are secured firmly at each end of the cylinder saddle by brackets *B*, Fig. 2, in such a manner that they can be adjusted by sliding them up or down to suit any required radius. The fulcrum shaft *C* is carried by the

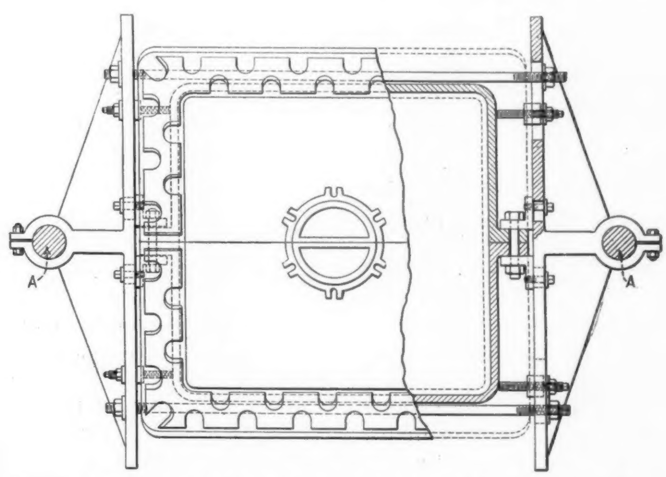


Fig. 1—Method of applying the fulcrum shaft support bracket to the cylinders

bearing located at the top of the vertical supports *A*. An ordinary cylinder boring bar can be used for this purpose without any alterations. The milling machine assembly is suspended from it.

The radius arm hanger, through which the fulcrum shaft passes, is made in two parts. The upper part *D* is secured to the fulcrum shaft *C* and contains a half-nut which engages with the fulcrum shaft lead screw. This nut can be disengaged at the will of the operator by means of a release spring and an eccentric mechanism. The fulcrum shaft lead screw is equipped on one end with a hand wheel *E*, which facilitates moving the miller head horizontally. The lower part of the radius arm hanger *F* is secured to the upper part *D* by bolts the heads of which slide in an annular tee slot which is concentric with the

central recess of the upper hanger *D*. This arrangement permits the miller cutter to traverse its work either radially or horizontally, which requires a difference in position of 90 deg. The lower part of radius hanger *F* contains two sockets which receive the radius arms *G* which are adjustable in the sockets and can be clamped rigidly at any desired point by means of cap screws. The lower part of *F* also contains a radius nut which engages the radius adjustment screw *H*. For convenience, this screw is operated by a hand wheel through bevel gears which are carried on a bracket.

The lower ends of the radius arms *G* are fixed in the miller frame which carries the worm gear and the miller cutter assembly, the feed screw yoke, the feed screw bevel gears, the feed screw counter shaft and the feed gears all of which are clearly shown in Fig. 4.

The worm shaft of the driving gear assembly terminates in a shank of suitable size and shape to fit the air motor socket which allows the motor to be mounted as shown at *I* Fig. 3. The driven worm gear is mounted within the housing which is on the cutter shaft. This shaft extends through the housing and through the miller frame bearings. It carries on one end the driving feed gear and

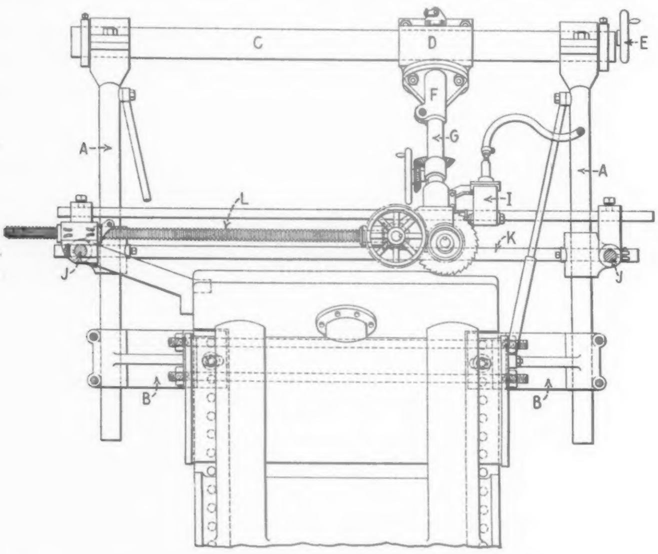


Fig. 2—Side view of the cylinder saddle milling machine

terminates on the other end in a tapered fit with a collar and nut for the purpose of securing the milling cutter when it is desired to mill in close places.

The main milling cutter is mounted on a shaft between the worm gear housing and the miller frame. When it is necessary to have the auxiliary cutter on the end of the shaft one should be used that is slightly larger than the main cutter between the frames. This will eliminate the removal of the regular cutter as it provides ample clearance for idling. The feed counter shaft carries on its outer end the feed gear which passes through the bearings in the frame as well as through the bearings in the yoke. The bevel gears are carried in this yoke with the driving gear mounted on the counter shaft and the driven gear on the feed screw.

The adjustable brackets are secured on each vertical support *A*, which, in turn, secure the transverse anchor rods *J*, Fig. 3. These rods terminate in eyes, through which passes the longitudinal anchor rod *K*, Fig. 2. The removable feed screw nut-assembly is hinged to the anchor rod *K*. The feed screw split nut assembly consists of two saddle nuts that engage the feed screw *L*, Fig. 2. These nuts are contained in a cage in such a manner that they can be engaged or disengaged from the feed screw at the will of the operator, by means of the operating rod *M*, Fig. 2, and engaging the split nut operating slides. The lower part of the split nut housing forms a hook which hinges on the anchor rod *K* which is closed by filler blocks in such a manner that the whole assembly is free to swing on the anchor rod.

From the manner in which the feed screw split nut

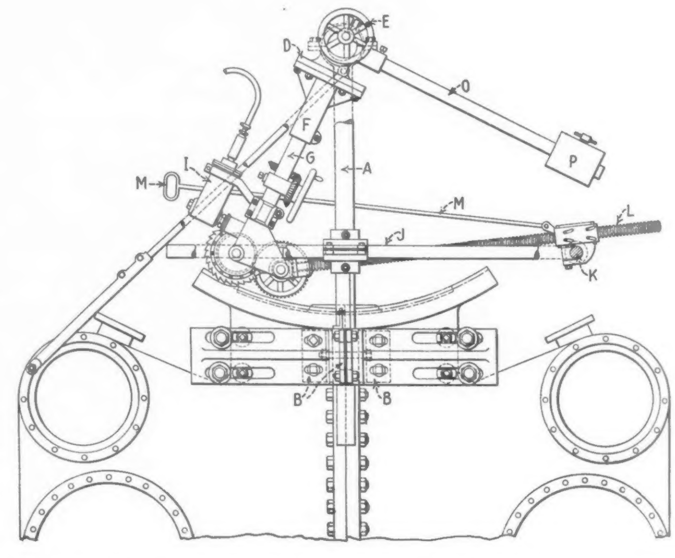


Fig. 3—Front view showing the method of mounting the cylinder saddle miller

hinges on the anchor rod *K* and the feed screw yoke hinges on the shaft connecting it with the miller frame, it is obvious that the miller head will be drawn toward the anchor rod *K* and that the feed screw *L* will always be in perfect alinement at all positions of the miller-head.

When milling the side flanges, the feed screw split nut

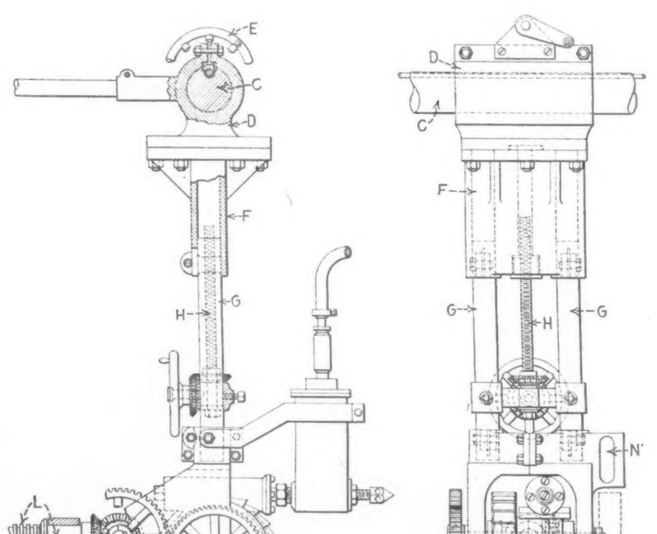


Fig. 4—Miller head and radius arm for the cylinder saddle radial miller

is removed from the rod *K* and placed on the transverse anchor rod *J*. The Miller-head is turned 90 deg. from its former position. A guide rod is then passed through the slot *N*, Fig. 4, which is secured at each end to the anchor rods *J* by suitable brackets. It can be slid along the rods *J* and fastened at any desired point but they must be set

at a different point each time a longitudinal cut is taken in order to move the cutter over in position for a new cut. When making these longitudinal cuts, the saddle nut is disengaged from the lead screw, allowing the radius arm hanger to slide along the fulcrum shaft *C* as the cutter advances. A spacer bracket attached to the rod *J* and heels against the cylinder saddle serves to stiffen the anchor rod *J* when making the longitudinal cuts. The upper part of the radius arm hanger *D* has a socket in which the counter weight lever *O*, Fig. 3, is fixed, which carries the counter weight *P*. The vertical supports *A* are diagonally braced by adjustable braces whose lower ends connect with the valve chamber or cylinder head studs. Referring to Fig. 1, the fulcrum, shaft support brackets have two horizontal slots in each end through which pass the tie rods or studs. Spacer screws also are set in these slots. These slots make it possible to fit the brackets to different widths and styles of cylinder saddles, allowing the tie rods to lie up close to the neck of the cylinder saddle, thus insuring a more rigid anchorage of the brackets. The spacer screws serve to stiffen the support brackets at the points where the tie rods exert their pressure. They also engage with specially designed nuts that have projecting lugs which fit in the tie rod slots. These nuts have shoulders or flanges that lap over the edges of the slots on the inner face of the support brackets. The spacer screws are of sufficient length to pass through the nuts and to the end surfaces of the neck of the saddle.

Near the center of the support brackets are four smaller slots through which pass the cap screws which screw in the angle brackets located on the inner surface of the support brackets in such a manner that the splice flanges of the cylinder saddles come vertically between them. The part of the angle brackets that meet the splice ranges are slotted so that an alinement can be made with one of the bolt holes already in the splice flanges. A clamp bolt nut is put through the angle brackets and splice-flanges when the clamp bolt is tightened. The support brackets *B* are adjusted laterally in such a manner that the center of the receiving sockets for the vertical supports *A* line up vertically with the center of the cylinder saddle. When this adjustment is made the cap screws are tightened, thus insuring a rigid central support that holds the fulcrum shaft accurately in position. The spacer screws are then adjusted until they press firmly against the neck of the cylinder saddle after which the tie rods may be drawn tight. There are milling cutters on the market having inserted teeth that can be used to advantage in this machine. The machine can be driven by either an air or an electric motor.

Pointers on forging machine dies*

Die design and construction not a one-man job—Co-operation between forge shop and tool room desirable

The success of forging machine dies in railroad shops depends on their correct design, the use of proper materials in their construction and accurate die alinement in the forging machines. Experience has shown that where greater heat resisting properties than possessed by carbon steel are required, chrome, or tungsten alloy steel should be used, the application being in the form of inserts wherever possible in order to reduce the first cost.

The principal causes of die deterioration are generally recognized as abrasion, heat and pressure. Excessive pressure is the least of forging die problems as the gripping dies and heading tools are generally heavy enough to withstand the forging pressure. Abrasion, that ever present factor which causes ultimate deterioration of dies but not necessarily their early failure, cannot wholly be prevented. The skill of the designer plays an important part in designing dies in which excessive abrasion takes the longest time to develop. The constant jets of water which should play on the dies while in operation are depended upon to minimize abrasion by working the scale out of the impressions as well as keeping the dies cool.

Observation has shown that heat is the greatest enemy of satisfactory die life. This fact may be readily observed where the die impression or header is surrounded with hot stock in its operation, such as is the case with bushing dies, pin slot punches, or castellated nut dies. Dies subject to a great amount of heat, or used for the production of a large amount of forgings in rapid succession, held to certain close limits, should be made of alloy or other steel with high heat resisting qualities. Dies constructed of steel for this class of work give more service, better forgings and are less expensive to maintain.

An example of a case of this kind may be mentioned as follows: A set of bushing dies was sunk in cast iron blocks with die block steel headers and punches, 500 to 600 bushings being about the limit of production of these dies without re-working. The cast iron dies were replaced with steel dies (45 to 50 point carbon) and the production increased to 1,500 bushings before repairs were needed. Even then it was simply necessary to straighten up the edges where they had turned in from heat and pressure.

It must be understood that cast iron dies should not be entirely dispensed with, for in certain forging operations such as welding, cast iron gives better results than steel. Again, where a number of forgings are needed which will never be duplicated, cast iron is the logical material to use as it represents a much smaller investment than steel and does the work just as well. Die service depends to a certain extent upon the skill of the operator in making sure that the material worked with is properly heated and gaged so that when the dies close it will be upon the proper amount of material to make the forging. All this means longer life of the dies and less up-keep expense on the machines.

Co-operation between the forge shop and the toolroom go a long way toward reducing the cost of maintenance, and the construction of new dies. It is no one-man's job. Exchanging ideas brings the best results.

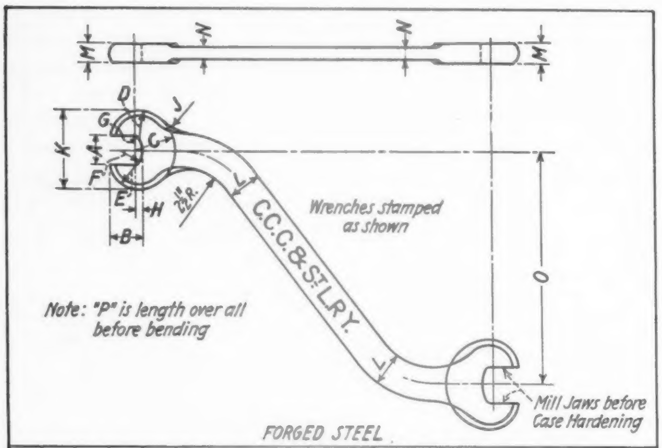
In preparing a paper on this subject your committee

*Abstract of a regular report of the Committee on Forging Machine Dies presented at the thirteenth annual convention of the American Railway Tool Foremen's Association held in Chicago September 2, 3 and 5, as reported on page 639 of the October *Railway Mechanical Engineer*. The report was read by Chairman E. A. Hildebrandt, tool foreman of the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove shops, Ind., who is the new president-elect of the association. Other members of the forging machine die committee included C. B. Heingarten, Chicago & North Western, Chicago; C. C. Burke, Chesapeake & Ohio, Peru, Ind.; A. C. Roepke, Union Pacific, Los Angeles, Cal., and C. Petran, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.

is aware of the fact that there is perhaps little information we could offer that is entirely new, but we are pleased to be able to furnish information regarding dies which we feel have been a real factor in reducing the cost of shopping locomotives and cars.

Following are several drawings and explanations of practices on the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove shops, Ind.

S-Wrenches—These are made on a 4-in. forging machine and a Bradley hammer. The dies are made of die block steel (55 to 60 point carbon). The Bradley hammer dies are hardened and tempered, the forming and punching die and headers not being hardened. The first operation in forging S-wrenches is cutting to proper length a piece of machine steel 1/4 in. smaller

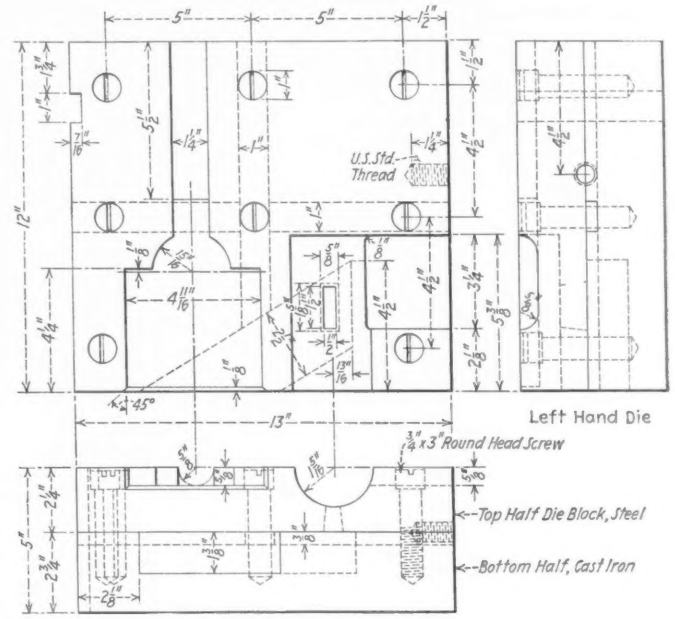


P	O	N	M	L	K	J	H	G	F	E	D	C	B	A	SIZE	WRENCH No.	LINE No.
10 1/2"	4 1/2"	5/16"	5/16"	5/8"	1 3/8"	5/8"	5/16"	1/8"	5/8"	1/2"	–	9/16"	41/64"	17/32"	1/4"	7	1
				5/8"	1 3/8"	5/8"	5/16"	1/8"	3/4"	5/8"	–	11/16"	55/64"	23/32"	3/8"		2
15"	7"	3/8"	9/16"	1"	2 3/8"	11/16"	1/4"	17/64"	35/64"	7/8"	1"	1 15/64"	1 1/64"	29/32"	1/2"	1	3
			5/8"	1"	2 3/4"	13/16"	9/32"	5/32"	27/32"	1 3/32"	1 15/32"	1 21/64"	1 7/64"	1 3/32"	5/8"		4
17 1/2"	7"	7/16"	11/16"	1 1/8"	2 31/32"	13/16"	21/64"	19/64"	15/16"	1 3/64"	1 1/4"	1 19/32"	1 13/64"	1 9/32"	3/4"	2	5
			3/4"	1 1/8"	3 1/2"	13/16"	25/64"	1/8"	1 1/16"	1 9/32"	1 1/2"	1 45/64"	1 1/2"	1 15/32"	7/8"		6
20 1/2"	7"	1/2"	13/16"	1 1/4"	3 5/8"	13/16"	27/64"	19/64"	1 13/32"	1 15/32"	1 3/8"	1 53/64"	1 19/32"	1 11/16"	1"	3	7
			7/8"	1 1/4"	4"	13/16"	31/64"	5/16"	1 13/32"	1 1/2"	1 11/32"	1 15/16"	1 23/32"	1 7/8"	1 1/8"		8
24"	7"	23/32"	1"	1 1/2"	4 13/32"	13/16"	33/64"	5/16"	1 3/4"	1 3/4"	–	2 7/32"	2 1/64"	2 1/16"	1 1/4"	4	9
				1 1/2"	5 3/16"	13/16"	37/64"	5/16"	2 1/16"	1 19/32"	–	2 19/32"	2 11/64"	2 7/16"	1 1/2"		10
28"	10"	15/16"	1 1/4"	2"	5 9/16"	1"	39/64"	5/16"	2 7/32"	1 27/32"	–	2 25/32"	2 27/64"	2 5/8"	1 5/8"	8	11
				2"	6"	1"	21/32"	5/16"	2 3/8"	2 7/32"	–	3"	2 49/64"	2 13/16"	1 3/4"		12
10 1/2"	2 3/4"	3/8"	3/8"	3/4"	2 3/4"	5/8"	1/4"	1/8"	5/8"	1 1/16"	–	1 3/16"	1 9/32"	25/32"	1/2" Cap Screw	6	13
				3/4"	2 3/4"	5/8"	1/4"	1/8"	5/8"	1 1/16"	–	1 3/16"	1 1/64"	29/32"	1/2" Std. Nut		14
10 1/2"	2 3/4"	3/8"	9/16"	1"	2 3/8"	5/8"	1/4"	17/64"	35/64"	7/8"	–	1 15/64"	1 1/64"	29/32"	1/2"	5	15
				1"	2 3/4"	13/16"	9/32"	5/32"	27/32"	1 3/32"	1 15/32"	1 21/64"	1 7/64"	1 3/32"	5/8"		16

S-wrench made on Bradley hammer and 4-in. forging machine

than two times the dimension *D* in the wrench drawing. Next a ball is formed on each end and the handle of the wrench is drawn out; the ball on each end is flattened to approximately the finished side of the outside diameter of the jaws of the wrench, these operations all being done on Bradley hammer balling dies. The next operation is done in the forging dies with the first operation header, which punches and forms the jaw; the wrench is then passed to the next impression and the header, which is 1/16 in. larger than the punching header, forms the outside dimensions, leaving enough stock in the jaw for machining the wrench to standard size. The fourth operation consists of bending the wrench to the proper shape on a small bending machine which is near the forging machine. The second, third and fourth operations are all made with one heat.

All wrenches are forged smaller in the jaws than the nut size and are milled to size with a pair of straddle cutters. The wrenches are held in an air clamp while

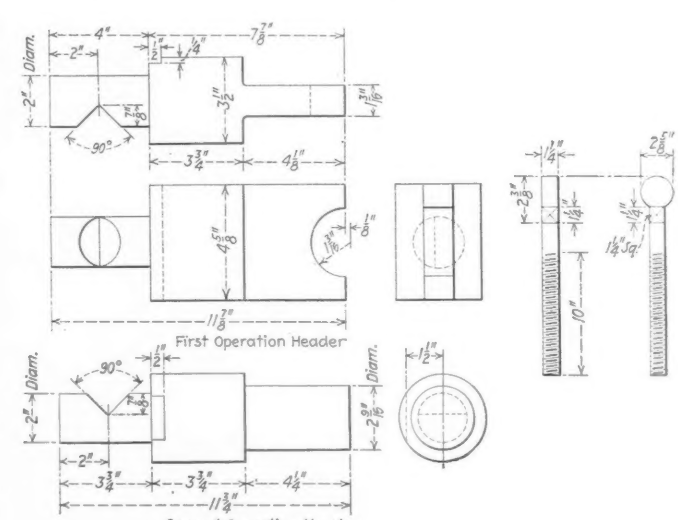


Forging die for 1¼-in. wedge bolt

milling, the burrs being ground off and the wrenches then case hardened.

The production of 1¾-in. wrenches on the Bradley hammer is three an hour; the production on the forging machine is ten an hour, this production increasing on the smaller size wrenches.

Wedge bolts—The dies for wedge bolts, made of die block

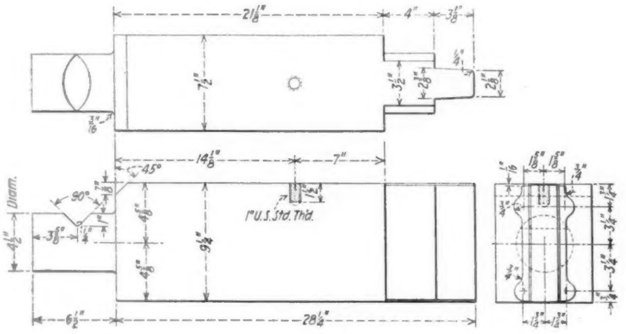


Header dies for 1¼-in. wedge bolt—Dimensions of bolt

steel backed with cast iron, are used on a 2½-in. forging machine. The diameter of the wedge bolt head for the 1¼-in. bolt is 2⅝ in., the thickness being 1¼ in. and it takes approximately 5 in. of stock to make this bolt. The work is done in one operation by allowing the header to enter the die before it strikes the material. The header upon entering the die begins to form a pocket in which the stock is carried forward until it forms the head of the bolt. The surplus stock or flash flows into the ¼ in.

clearance space between the header and the dies when the header is at the end of its stroke. This flash is trimmd off in the next pass of the dies and the slugs drop out at the back of the die through the 1⅜-in. by 2½-in. slot shown on the forging die drawing.

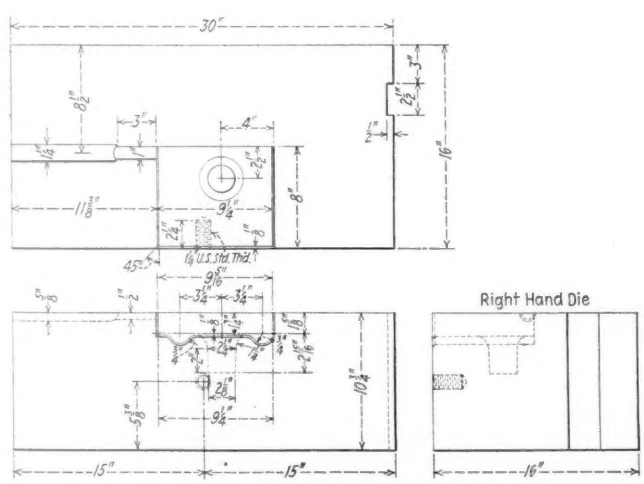
The bolts are taken to the punch press and in two operations the head is sheared to a limit of .002 in. in diameter by being punched through a shearing die. The bolts are then threaded, sent to the storehouse and ordered out as needed. A tolerance of .007 in. between the size of the bolt head and the hole in the wedge is maintained. There is no unnecessary filing or grinding to do; the wedges and the bolts are ready for application when ordered from stock.



Header die for radius bar lifter

The idea of making the die in two parts was mainly to simplify machining operations. Thirty wedge bolts is the average production for an hour on the forging machine; bolts are trimmed to size at the rate of 50 an hour.

When a header of this kind breaks, the broken end is cut off and a slot is cut in the body of the header which then answers the purpose of an adapter for a new header blade. The blades are held in place by bolts of suitable size, which the snugly fitted in both the blade and adapter.



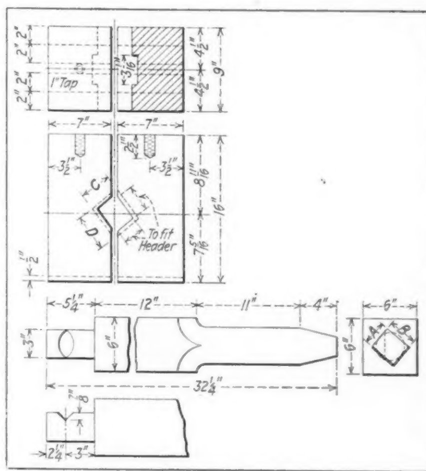
Forging die for radius bar lifter

This method of repairing saves considerale time and material as the blades for various kinds of headers are kept in stock and when one breaks all that is necessary is to change blades. Otherwise, it would mean a complete new header. Die block steel costs money as well as time to machine it. Here is a chance to save several dollars on each header if you are not already repairing them this way.

Radius bar lifter boxes—These boxes are forged in one operation. The dies are sunk in 11-in. by 16-in. by 30-in. cast iron blocks with a die block steel header and are used on a 7-in. forging machine.

As it would be difficult to make steel flow in one operation to make a forging of this kind, iron is used which is cut into 2⅝-in. by 5-in. by 8-in. blocks which are heated up to a white heat and a porter bar welded on. They are then passed into the dies from the top of the machine. It is more of a squeezing than an upsetting operation and it is very essential that the metal be thoroughly heated so that the bearing ends of the box will fill out with the least resistance and minimum strain on the dies and machine. An everage of four boxes an hour can be produced with these dies. The trimming is all done by the machine operator.

Small spring bands.—The first operation in forging small spring bands is to cut material of the proper thickness and width and bend it on an air machine to form a rectangle approximately the size of the band, allowing enough stock in length to make a scarf weld. The second operation is performed in the dies, the partly finished band being heated to a welding heat at the scarf and placed in the pocket of the dies; the header passes through the band and forms and welds it, the surplus stock, if any, flashing out either at the front or back end of the die. This flash is trimmed off by the machine operator and the band is ready for application to the spring leaves.



USED ON	D	C	B	A	DIE No.	LINE No.
4" Mach.	4⅞"	2½"	4⅛"	1¾"	159	1
"	3⅞"	2¾"	3⅛"	2"	160	2
"	3⅞"	3⅛"	3⅛"	2⅜"	161	3
"	3⅞"	3½"	3⅛"	2¾"	162	4
"	3⅞"	3⅞"	3⅛"	3⅛"	163	5
"	4¼"	3⅞"	3½"	3⅛"	164	6
"	4⅜"	2¾"	3⅝"	2"	165	7
"	4⅜"	3⅛"	3⅝"	2⅜"	166	8
"	4⅜"	3½"	3⅝"	2¾"	167	9
"	5⅝"	4⅜"	3⅞"	3⅝"	168	10
"	4⅞"	3½"	4⅛"	2¾"	169	11
"	4⅞"	4"	4⅛"	3¼"	170	12
"	4⅞"	4⅜"	4⅛"	3⅝"	171	13
"	4⅞"	4⅞"	4⅛"	4⅛"	172	14
"	5⅜"	3⅛"	4⅝"	2⅜"	173	15
"	5⅜"	3½"	4⅝"	2¾"	174	16
"	4⅞"	3⅛"	4⅛"	2⅜"	186	17

Small spring band dies and header

Large spring bands—The first operation in forging large bands is to shape and bend the stock on the bulldozer as shown in the insert sketch. Enough stock is allowed when cutting to length to assure proper thickness of the spring band on the heavy end. In this set of dies it will be noticed that the header does not pass through the spring band, but that the inside dimensions of the band are formed by the bosses on each half of the dies. The header strikes the long end of the partly shaped band, and welds and forges it to thickness in one operation. The ⅞-in. groove cut in the dies is an outlet for surplus stock.

It is not necessary to heat the band all over, but to a good welding heat on the ends that are to be upset and welded. A back stop must be used to hold the band in the dies. These dies, used in a 4-in. machine, are sunk in cast iron which we find is much better than steel for this kind of work. Steel checks much quicker than cast iron and forgings are more apt to stick in the dies. The headers are made of die block steel. An average production of 10 bands an hour is secured with these dies.

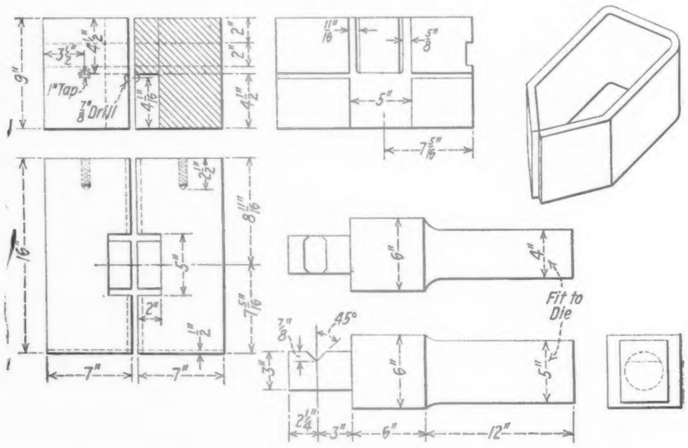
Brake beam safety straps—These straps are made of 2-in. by 2-in. by ⅜-in. angle iron in one operation on the

bulldozer. The header is mounted on a wrought iron plate bolted to the head of the machine. This header has a die block steel insert which contains the three 13/16-in. punches and is removable. Should it be necessary to change punches, the insert is removed by taking out two fillister head set screws; standard boiler punches (made of 90 point carbon steel) which are kept in stock are applied. The change can be made with very little delay to production, as it is not necessary to remove the header from the machine.

The die portion of the former is made of machine steel and is mounted on a cast-iron sub-plate bolted to the bed of the machine. The punching die is made of tool steel and is held in position by two dowel pins and two screws.

The old way of making the straps required the bending, laying out and drilling operations as well as extra trucking. The laying out, drilling and a part of the trucking expense has been eliminated as the work is all done (with the exception of shearing to length) in one machine. The straps are heated in an oil-burning furnace and a production of 40 finished straps an hour is realized.

Brake staffs—A set of sliding block dies is used in a 7-in. machine for upsetting the square part of a brake staff. The bodies of the dies are made of cast iron and



Large spring band dies and header—Insert shows band after first operation of bending on bulldozer

the sliding block and header are of die block steel. The cast iron section of the die holds the work and is milled with a 1/32-in grip.

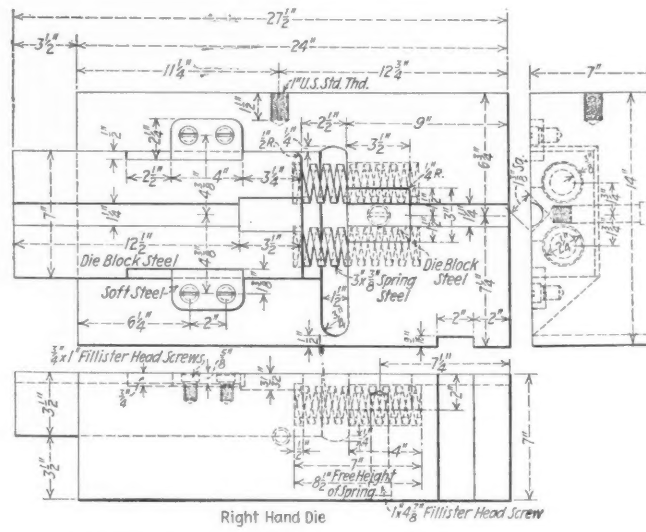
The sliding block is bored to the size of the stock and contains the impression of the square. As the square part on the brake staff is 2 ft. 10⅛ in. from the end it is necessary to drill a hole ⅛ in. larger than the size of the stock through the header through which the stock is passed. It is essential that the bars for the brake staff all be the same length to avoid buckling in the header and crosshead on account of too much stock.

A 1½-in. steel bar is placed in the hole in the crosshead, cut to the proper length so that when the crosshead comes forward the bar strikes the end of the brake staff at the same time the header strikes the sliding block which carries the stock forward and forms the square. The brake staffs are all gaged from the back stop on the machine.

The scale from the work drops out through the 1½-in. channel shown on the drawing. On the return stroke of the machine the springs push the sliding block back to its starting position.

Fourteen brake staffs an hour can be squared with these dies. It is very important that the heats be gaged the proper distance from the end of the bars, to avoid the possibility of damage to the dies if allowed to close on improperly heated stock. The length of the heats must be gaged in proportion to the amount of material to be upset. Too long a heat will cause the stock to buckle.

A die house is provided at Beech Grove where all dies and templates used in the forge shop are kept. There are over 850 sets of dies and special punch press tools which are looked after by one man, who keeps the dies and headers in relative order, cleans them and wipes them with oily waste to prevent rusting, checks them in and

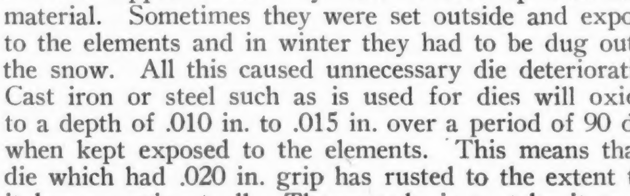


Sliding block forging dies for 1¼-in. brake staff

out and sends them to the toolroom whenever repairs are needed.

The dies are all numbered, blocks with two sets of dies in them having two numbers. The machine operator is furnished with a set of checks which are used only for checking out sets of dies as needed. The check is hung on a board together with the number of the die. When the job is completed the dies are returned, inspected, and if in need of repairs are sent to the toolroom. This system eliminates the practice, sometimes followed where there are duplicate sets of dies, of obtaining another set of dies without reporting that the set which was in use failed or needed repairs. It also assures one good set of dies while another is being repaired.

Before the die house was built, dies were left around



Header die for 1¼-in. and 1⅜-in. brake staff

the machines in the shops, taking up valuable space, and it often happened that they were covered up with heavy material. Sometimes they were set outside and exposed to the elements and in winter they had to be dug out of the snow. All this caused unnecessary die deterioration. Cast iron or steel such as is used for dies will oxidize to a depth of .010 in. to .015 in. over a period of 90 days when kept exposed to the elements. This means that a die which had .020 in. grip has rusted to the extent that it has no grip at all. The remedy is to take it to the toolroom, grind or plane some off so the dies will hold—all an unnecessary waste of time and material. Dies are invested capital and must be taken care of in order to

give the best results and yield the greatest returns from the investment with the least possible amount of maintenance cost.

Maintaining the precision reverse gear

By A. T. E.

IN order properly to maintain the Franklin Precision reverse gear, it is necessary to grind the seats of the slide valve occasionally and to renew the cylinder packing leathers. It is impossible to remove the valve operating arm without taking out the back cylinder head. The two cast iron face plates shown in the sketch were made for the purpose of regrinding the joint between the slide valve and its seat. The work of grinding in a slide valve has often been a bigger job than the enginehouse foreman likes to admit, especially when locomotives are being

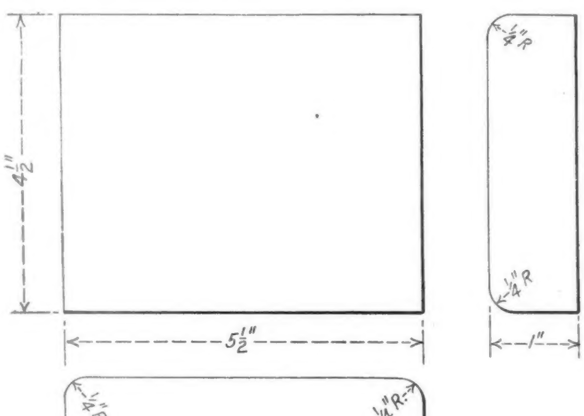


FIG. 1

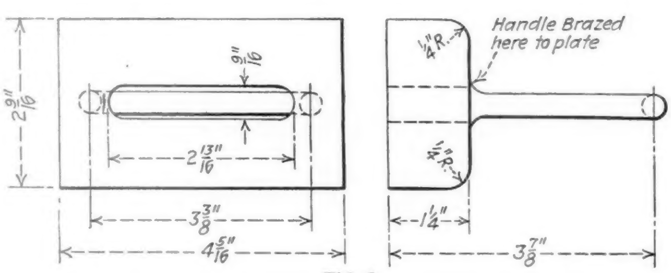


FIG. 2

The face plate shown in Fig. 1 is used to grind the slide valve—Fig. 2 is for the valve seats

turned on short time. However, by the use of these face plates, a mechanic has only to remove the slide valve chest cover and the slide valve in order to grind the seat with the face plate shown in Fig. 2 of the sketch. The valve is ground with the face plate shown in Fig. 1 and the reverse gear is then assembled for service.

In order to keep the face plates true, they should be machined occasionally and frequently lapped and ground together. By using these plates reverse gears can be kept in good condition with little loss of time and there will be few occasions where a locomotive will be held for repairs to the reverse gear only.

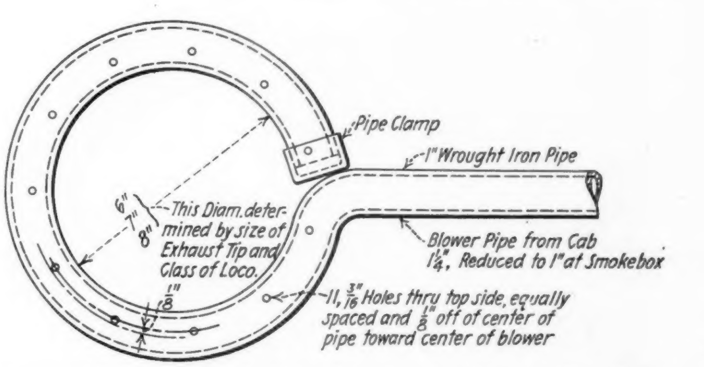
In order to renew the reverse cylinder cup leathers, it is necessary to remove both the front and back cylinder heads. There being no counterbores in either end of the cylinder it is a difficult job to slip a piston through with new cup leathers. However, by assembling the piston at the bench, the back cup leathers can be guided into place by the use of thin tin strips. One objection to this method is that it is usually quite difficult to get the back leather into the cylinder and the triple screw into the piston trunk at the same time.

A better way of doing this job is to slip the back cup leather and the piston follower from the front into the back end of the cylinder at the beginning, and then place the indicator block in the cab in the extreme forward position. As the mechanic starts the screw into the piston trunk, he pulls the balance of the piston parts as far into the cylinder as possible by rotating the hand wheel in the cab as if reversing the engine. Usually the follower stud holes in the piston head will not line up with the follower studs when reassembling the piston. When this occurs, run the piston ahead a few revolutions of the hand wheel and clamp a wrench on the flat end of the piston trunk, turning it a little to the left, and at the same time hold the screw from turning. Then run the piston to the back of the cylinder until the studs are inserted in the follower stud holes in the piston head. Screw a couple of nuts on the studs by hand and move the piston to the front cylinder where all the nuts on the studs can be tightened more conveniently.

Locomotive blower pipe

THE Minneapolis & St. Louis has experimented recently with a blower of the design indicated in the drawing which apparently has important advantages over some of the other types commonly used.

This blower is circular in shape and made from common wrought iron pipe in the shop. The blower lies flat on the table plate, fitting snugly around the outside of the nozzle tip. The end of the blower is closed with a pipe cap and is attached to the blower line in the usual manner. Holes 3/16 in. in diameter, equally spaced and usually about 1½ in. apart are bored in the top of the blower

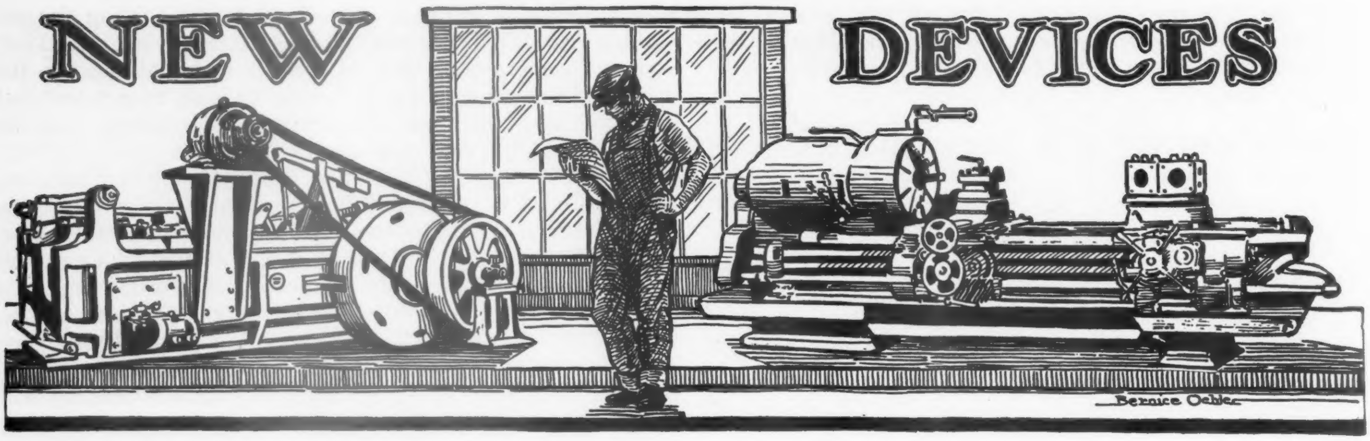


Locomotive blower which has given good results on the Minneapolis & St. Paul

⅛ in. off center and pitched so that the several jets of steam converge at the choke of the stack.

The diameter and size of the blower and number of holes is determined by the size of the nozzle opening. On engines having a 4-in. tip, ¾-in. pipe is used and on engines having a 6-in. nozzle tip, 1-in. pipe is used.

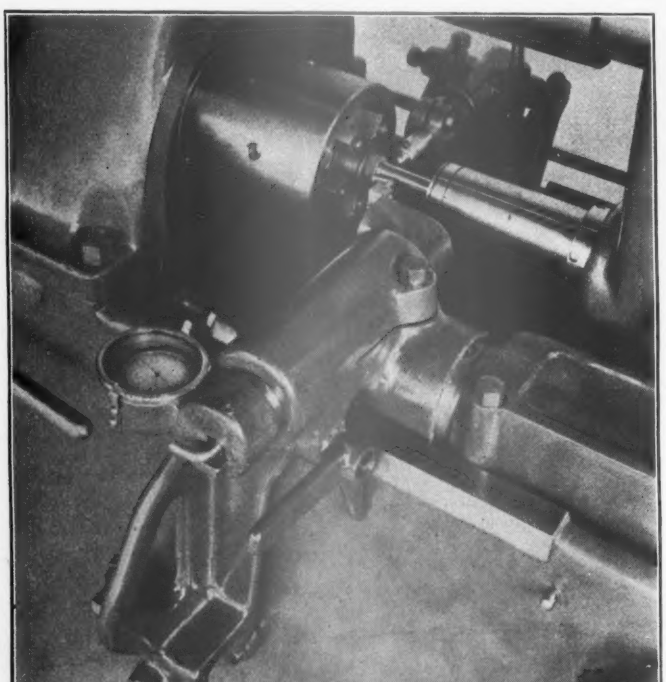
Actual tests have shown that this type of blower uses only one-fourth the usual amount of steam required for blowing up a boiler. It is far more efficient and in addition is practically noiseless, a desirable feature particularly around passenger stations and in enginehouses. Some of these blowers have been in service for more than a year, and require practically no maintenance.



Improvements in Bryant internal grinders

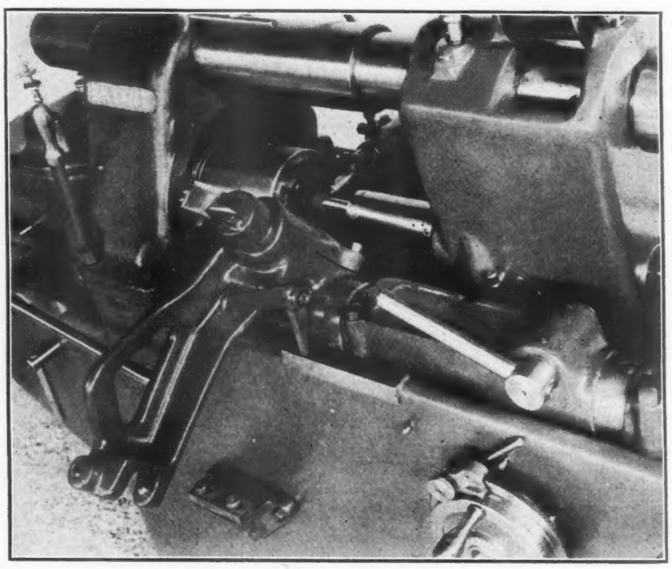
FOUR major improvements have been made by the Bryant Chucking Grinder Company, Springfield, Vt., which can be applied to any standard Bryant hole grinder. All of these improvements are found on the No. 6 semi-automatic hole grinder which is particularly adaptable to railway shops.

The first of these improvements is an automatic size indicating attachment, the use of which enables the operator to know when the desired diameter of a hole has been reached without the necessity of constant measuring with a plug gage. When in position, it does not interfere with the movements of the operator. It consists



Automatic size indicating attachment applied to a No. 6 Bryant internal grinder

primarily of a diamond gaging point in contact with the bore of the hole being ground, a dial indicator and means for communicating the movement of the gaging point to the dial of the indicator. All working parts, including the indicator, are enclosed to protect them from water and grit. A glass cover is fitted over the dial. The gaging point is a diamond carried by a small arm that projects into the hole. The diamond is smoothly finished on the contact surface to the radius of the smallest hole to be ground. The whole device is movable endwise by means



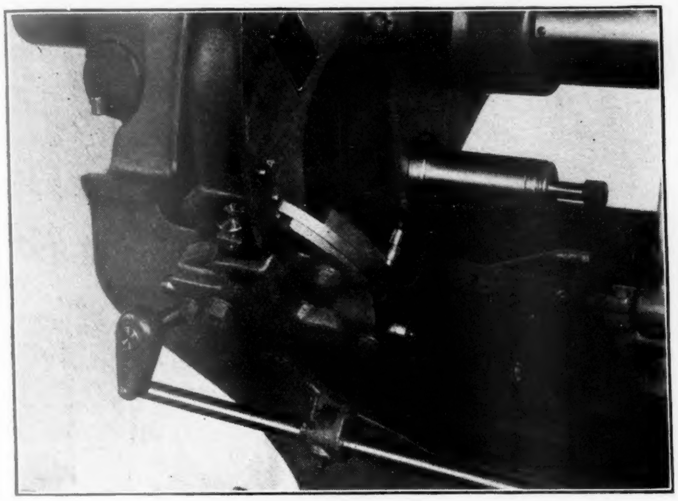
Adjustable wheel truing device in position

of a lever so that the gaging point may be instantly withdrawn from the hole and swung out of the way when changing the work.

It is a simple matter to set up the indicator. The first piece ground is finished to the desired size, being checked with a master gage. The gaging point is then brought in contact with this finished surface of the hole and the dial indicator is set at zero. All subsequent holes ground will be to the correct size when the dial indicator registers zero. After the grinding wheel has been started in a piece of work, the gaging point is brought into the hole, the diamond resting against the wall of the hole opposite the grinding wheel. The dial, previously set to the size of the hole required, immediately registers the amount that the hole is smaller than the normal size. This dial is graduated to indicate tenths of thousandths of an inch.

In order to prevent the wear of the diamond gaging point, especially when grinding holes with a rough surface, means are provided for relieving the diamond a few

thousandths from contact with the surface. When the rough surface or scale in the hole has been ground out, the diamond is brought back into contact with the surface of the hole. If desired, the diamond may remain in contact with the wall of the hold throughout the grinding. As the diameter of the hole approaches the normal size, the point of the indicator moves toward zero. When the pointer is at the zero mark, the operator knows that the hole is finished to the required size. He then withdraws



Control bar adjustment for grinding tapers

the grinding wheel and takes out the work. No plug gaging is necessary.

The success which has been obtained with this attachment is attributed chiefly to the control, which is on the same general principle as used for the Bryant wheel slide. The indicator head is attached to a heavy bar with bearings far enough apart to give control. The bearings are wholly enclosed and protected against grit. The bar moves longitudinally and swings in the same bearings, thus eliminating the need of gibbed cross slides. For holding the contact point in position, an arm is provided which is located by the control plate. This arm also serves as a handle for operating. At the same time, maintenance of accuracy has been made possible without sacrificing ease of operation.

An adjustable wheel truing device, shown in one of the illustrations, has been developed for use in connection with the Bryant sizing indicator. A micrometer adjustment is provided for moving the diamond in or out. With this arrangement it is an easy matter to set the diamond exactly in line with the diameter of the finished hole. If desired, the diamond can be set so that the wheel is dressed every time it is withdrawn from the finished hole, the diamond being set so that only a fraction of a thousandth of an inch of the wheel is removed, just enough to clean the surface and straighten the wheel. One pass of the wheel in front of the diamond as it is withdrawn from the hole is all that is necessary and this is automatically taken care of without any extra motion.

The chief advantage of this method is that the wheel is always straight and in perfect cutting condition, thus insuring better work both with regard to size and finish. It has also been found in many tests that the loss of wheel from dressing is less with this method than when the wheel is trued only when the operator happens to think of it. This diamond holder is operated by a lever conveniently placed so that it can be swung up out of the way when chucking or removing the work.

To facilitate the setting up of the machine for grinding taper holes, a micrometer adjustment, shown in one of the illustrations, has been provided for the control bar on the wheel slide. The swinging plate is accurately graduated up to a 45-deg. included angle. By the use of a special plate, an included angle of 60 deg. can be ground.

The flat control plate has been replaced with a round bar held in a swivel plate. This control bar is located in alinement with the slide bar when grinding straight holes. It engages a roll in the cross feed screw which minimizes wear. If wear does occur after considerable use the control bar can be turned in its seat slightly without losing its alinement. The control bar is clamped by two screws. The swivel plate, which carries the bar, is also clamped in place by two screws.

A hand lever has replaced the hand wheel as standard equipment for operating the chuck on Bryant grinders. The chuck operating lever is conveniently placed and helps increase the production with less exertion.

Solutions to prevent corrosion

ACIDS, alkalies, and moisture are the three main factors which cause the corrosion of steel railway rolling stock. Tests have proved that it is important that a protective coating should penetrate the exposed pores of the metal or surface to be protected. It should adhere firmly and fill every hole and crevice to seal the surface against the destructive action of water, acids or alkali.

The Quigley Furnace Specialties Company, Inc., 26 Cortland street, New York, have placed on the market a corrosive preventative solution, known as Triple A. These solutions are compounded from coal tar derivatives, carefully heat treated and are claimed not to crack, chip or peel. They contain no vegetable or animal oils, grease or turpentine and are said to form a lasting union with the surface covered which does not allow moisture or gases to creep through to the metal. This prevents oxidation and the pitting action of electrolysis.

These solutions have been put to severe tests. Small crucibles about 3 in. high and ½ in. in diameter at the top, made from a porous clay were lined with the Triple A solution. In these crucibles, the following chemicals were placed: saturated solution of caustic ammonium fluoride; concentrated prussic acid; arsenious acid, and mercuric chloride. The crucibles were allowed to stand for two weeks after which the chemicals were removed. The acids and alkalies had not affected the Triple A solutions. There was no leakage through the porous clay which would have indicated at once that the solution had been eaten through by the chemicals.

A piece of 1/32-in. sheet steel was painted on both sides with the solution and after it had dried, was bent back and forth without showing signs of cracking or peeling.

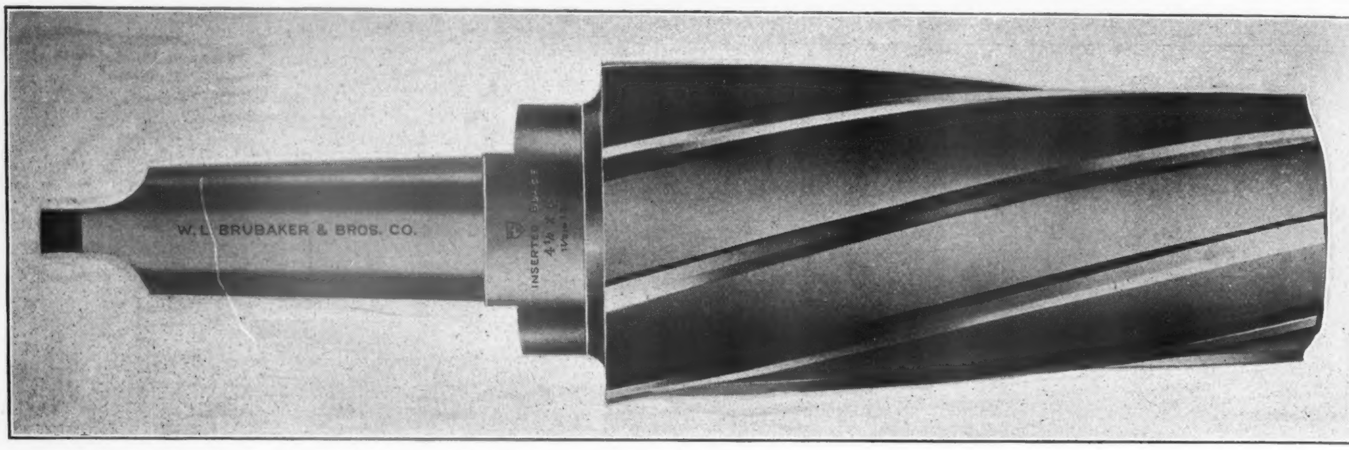
These solutions are applied with a brush on a clean metal surface, free from grease, dust or oil. They spread easily, leaving a firm, smooth and elastic surface. Triple A solutions are furnished in several colors, the usual standard base coat being black. Over this black may be applied additional Triple A colors, such as maroon, olive-green, deep-green, yellow, etc. The black solution will cover 300 to 400 sq. ft. of surface per gallon on iron or steei.

Spiral inserted blade reamer

WHEN the cutting edges of solid reamers are worn down to the point where they can not be reground, it is necessary to scrap the tool. This is a loss that can be reduced to a minimum by inserted tooth reamers. Such a reamer has been designed and placed on the market by the W. L. Brubaker & Brothers Company, 50 Church street, New York. The body of this reamer is made of a steel which can be subjected to abuse without any possibility of breaking or twisting.

The blades are made of high-speed steel and are heat treated so as to stand great strain without breakage. New blades can be furnished but as they are inserted by a special process, the reamer body should be sent to the factory for this work in order to obtain the best results.

The reamer can be obtained in any taper and size above 3 in. in diameter.



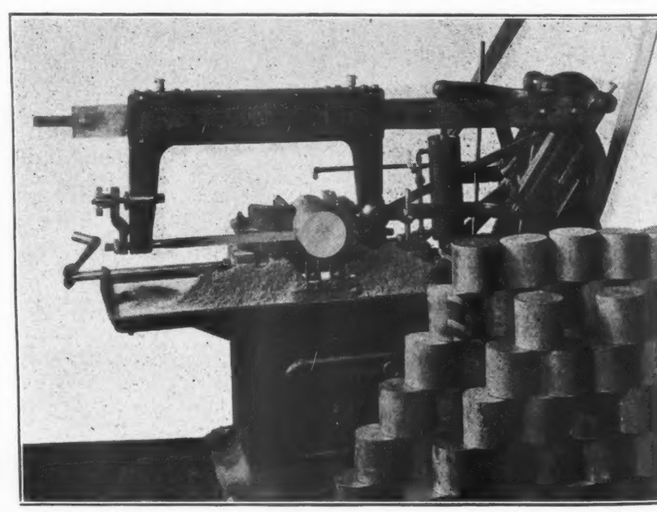
Brubaker spiral inserted tooth reamer

Atkins Silver Steel hacksaw blade

IT has been generally recognized among the users of power hacksaw machines that it has been impossible to obtain the maximum production from these machines as the average hacksaw blade will not stand up under high speed cutting. The E. C. Atkins & Company, Indianapolis, Ind., now manufactures a hacksaw blade which it is claimed will withstand the hardest service to which it can be put.

Silver steel blade (new)			First Tungsten alloy blade (new)		
Piece No.	Time Min.	Time Sec.	Piece No.	Time Min.	Time Sec.
33	1	50	43	2	55
77	1	50	57	3	0
101	1	50	74	3	10
			Second blade		
127	1	50	1	2	25
150	1	50	25	2	30
184	1	50	44	2	55
205	1	50	67	3	25
215	1	50	79	3	50
			Third blade		
230	1	50	14	4	10
			Fourth blade		
250	2	0	5	3	5
288	2	0	41	6	55
			Fifth blade		
300	2	0	1	2	50
311	2	5	19	3	10
339	2	5	38	broke saw	
			Sixth blade		
356	2	5	17	2	40
400	2	5	52	3	30

The success of the Silver Steel blades is attributed to the quality of the steel from which they are made. Another important quality of these blades is the heat treatment which they receive. As a result, each blade will give the same amount of service with a very small variation and with very little variation in the speed of the cut from the first to the last. The teeth are carefully milled with round gullets and properly pitched and are set even on each side of the blade. The performance of these blades is shown in the table.



Atkins steel blade cutting 4⅝-in. steel gear blanks

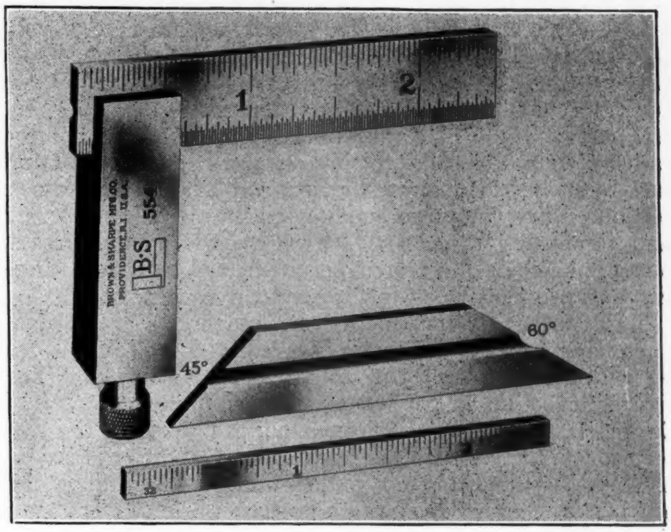
One Silver Steel blade made 400 cuts in the same time that the six blades of tungsten alloy steel made 298 cuts. The six tungsten blades averaged 49 cuts apiece.

Adjustable square with many uses

AN adjustable square which can be used as a graduated square, as a depth and height gage, for laying out work, for grinding tools, particularly drills, for checking a mitre, for squaring up small slots, for testing a 60 deg. angle and for measuring the depth of counterbores or holes has recently been made by the Brown & Sharpe Manufacturing Company, Providence, R. I.

It is furnished with three blades. Referring to the illustration, with the wide blade, the tool becomes a graduated square or depth gage. This blade and the bevel blade are 24/64 in. wide. The bevel blade is suitable for grinding thread tools and laying out angles and mitres. It has both 60 and 45 deg. angles and is reversible. The narrow graduated blade which is 1/8 in. wide enables the mechanic to reach inaccessible spots. The clamping device holds the blade in the body firmly and accurately. The square is easy to use; simply insert the blade to the position desired and tighten the knurled nut.

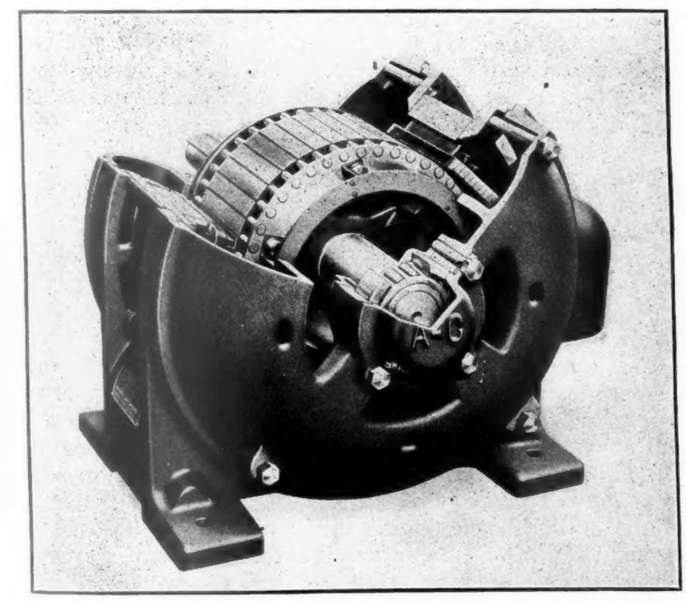
The blades are tempered and carefully ground and the graduations are clean cut and easily read. The body is hardened and ground.



Brown & Sharpe adjustable square with reversible blades

Roller bearing type motor

AFTER two years of experimental and development work, the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has placed on the market a complete line of 25 and 60 cycle squirrel cage and slip ring induction motors equipped with Timkin tapered roller bearings. The Timkin bearing was selected only after very careful consideration of the many questions of design and operation. After designs of bearings and mountings had been made, a number of motors of various sizes were built and tested under actual operating conditions of belt, gear, chain and coupled drives, a sufficient length of time to insure satisfactory service. The Timkin bearing has been used because of its ability to withstand continued heavy radial and thrust loads without undue heating or appreciable wear. It is particularly suited to heavy service and will operate satisfactorily at the high speeds found in the general purpose induction motor. Because of the rolling action of the bearing, there is practically no wear so that the factory adjusted air gap is maintained indefinitely, eliminating any possibility of the rotor striking the stator.


Sectional view of Type AR roller bearing motor

The important question of lubrication is greatly simplified, as grease is used requiring very infrequent attention on the part of the operator. The bearings have grease tight enclosures effectively excluding dirt or abrasive matter that might cause undue wear of the bearings. The mounting of the bearings is very simple, being only a light press fit for both the cone and cup, and not requiring the use of a lock nut or other means of holding the races in place. This also facilitates the removal of the bearings whenever necessary.

In addition to the bearings, special attention has been given to many other features of design of this line of motors. The frame is made of steel with feet cast integral, to withstand shocks. The coils are thoroughly insulated and baked in a water-proof varnish. The openings in the housings and frames for ventilation are so placed in vertical planes, that falling objects cannot enter the motor.

This motor can now be obtained in all ratings, 25 and 60 cycle, 200 hp. and smaller.

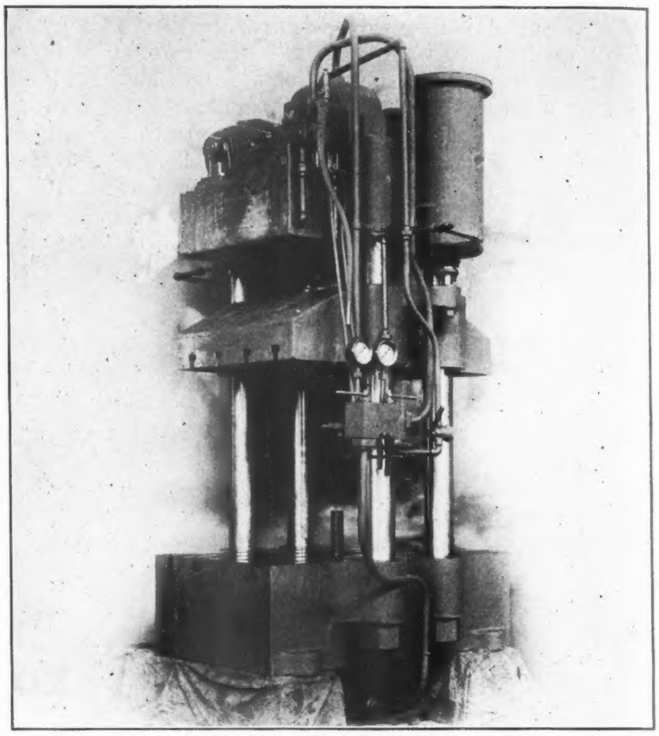
TESTING A FLANGED TEE.—Bulletin No. 2, recently issued by the Walworth Manufacturing Company, Boston, Mass., contains a complete description of a distortion test to a 4-in., 400-lb. working steam pressure, Walworth Sigma steel flanged tee made according to the American Engineering Standards Committee tentative standard dimensions. The tee was first submitted to an hydrostatic pressure test of 2,500 lb., after which the tee was fitted up with a 10-ft. length of 4-in. double extra-heavy pipe with a screwed steel flange on end, all of which was supported on 18-ft. centers. A total weight of 7,428 lb. was placed on the branch flange of the tee, which caused it to bend to the floor, or a total deflection of 27 1/16 in. The weight was removed permitting the pipe to spring back 4 3/16 in., leaving a permanent deflection of 22⅞ in. Finally the tee was again subjected to an hydrostatic pressure of 2,500 lb., which it withstood without any trouble.

Hydro-pneumatic press for railway shops

A SERIES of hydro-pneumatic presses designated as Model B, designed for railway shop use, have been placed on the market by the Chambersburg Engineering Company, Chambersburg, Pa. Exceptionally fast operation, complete accessibility of parts and ease of control enable these machines to meet the demands of the railway shop. The lighter presses are used for inserting and removing locomotive driving rod boxes and brasses, bushings, link hangers, bending and straightening levers and connecting rods, etc. The heavier capacity presses, one of which is illustrated herewith, are used for forming and pressing work in the steel car repair shop.

Fast operation is obtained by means of the hydro-pneumatic feature. The ram is brought down to the work by air pressure and the actual work is accomplished hydraulically under any pressure within the capacitv of the machine. A large weighted pullback assures the fast return of the ram. The simplicity of the presses is achieved by mounting the motor, pump and crane on the top plates, thus giving free access to the press from all sides. The top plate also forms the water reservoir. The controlling valves are mounted on the side of the machines and so placed as to give the operator an unrestricted view of the work and the gages without changing his position.

The machine shown in the illustration is a 300-ton, four-column press, provided with pneumatic pullbacks. Both the pressure ram and stripping ram advance rapidly to the work by pneumatic pressure, the actual work being completed by hydraulic pressure.



Chambersburg 300-ton hydro-pneumatic press

A push button starting switch

A PUSH button operated oil switch for starting squirrel cage induction motors directly across the line has recently been placed on the market by the Electric Controller & Manufacturing Company, Cleveland, Ohio. The device is known as the Type ZO starting switch and is controlled from one or more push button stations which may be located at convenient points. It is provided with four pairs of heavy contact fingers, three of which handle the main line in the case of three-phase or two-phase, three-wire motors, and the fourth pair handles the control circuit to the push button when the switch is arranged for no voltage protection. In the case of two-phase, four-wire switches all four lines are disconnected in the off position when the switch is wired for no-voltage release. When wired for no-voltage protection one line runs direct to the motor.

Push button operated oil switch for starting squirrel cage induction motors directly across the line

This switch uses an accurate inverse time element temperature overload device which consists of two alloy wires, each attached at one end to an adjusting screw and at the other end to a multiple lever which operates a quick make-and-break contact. The wire is connected across the secondary of a small current transformer. The gage of the expansion wire and the winding of the secondary of the transformer remain the same regardless of the horsepower ratings or voltage of the switch. The size of the wire and the number of turns of the primary is proportioned to suit the rating of the motor. An increase in current or an overload on the motor produces an increase in the current flowing in the secondary circuit, which causes the expansion wires to lengthen and, if the overload is severe enough or is of sufficient duration, the wires lengthen sufficiently to trip the overload relay contacts causing the starting switch to open and disconnect the motor from the line. The wires then cool and the overload relay contact automatically resets if a switch is wired for no-voltage protection. A

hand reset of the overload device by means of a small button projecting through the case is provided on switches arranged for no-voltage release.

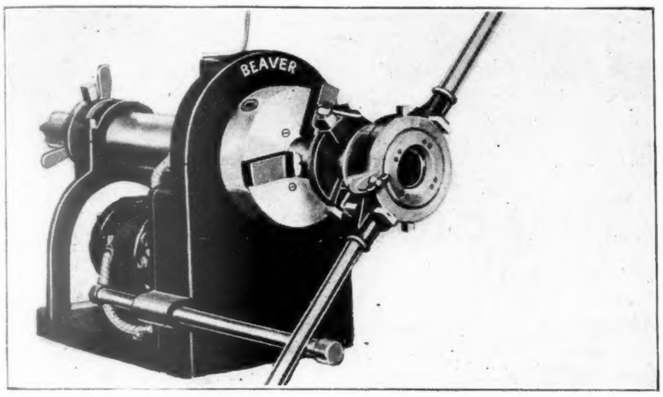
The overload device protects the motor against injury due to phase failure. If an attempt is made to start the motor with one phase open, the switch will open in less than five seconds, thus protecting the motor.

The oil tank will not leak as it is drawn from a single piece of sheet steel. The tank latches are arranged so that the tank can be lowered and left suspended to catch oil dripping from the contacts while the switch is being inspected. On account of the seepage of oil due to capillary attraction and from a slight splashing when the magnet surfaces engage, all moving parts of the switch are kept lubricated which protects the switch from corrosion when installed in corrosive atmospheres.

The switch is arranged for conduit connection and is of compact dimensions—13 in. high by 9 in. wide.

Portable power driven pipe threader

NO. 44 is the designation of a new portable electric machine recently placed on the market by the Borden Company, Warren, Ohio, for cutting and threading ¼-in. to 2-in. pipe, using any type or kind of hand operated die stocks or pipe cutters. A universal sliding extension shaft is furnished, however, to cut and thread up to 6-in. pipe, inclusive, using geared die stocks or cutters.



Borden portable power driven pipe threader with a capacity up to 6 in. inclusive

The operation of the machine is simple. The pipe is inserted and is rigidly held by a universal chuck. The die stock or pipe cutter is placed on the pipe as when cutting or threading by hand. The handle of the tool rests on a sliding bar at the side of the machine. When the current on, the pipe revolves while the tools stand still.

By using any type or kind of die stock or pipe cutter, this power drive virtually makes power machines of hand operated tools. It is also used to make up fittings in the machine, instead of by hand, thus performing a complete job of cutting, threading and fitting without removing the pipe from the machine.

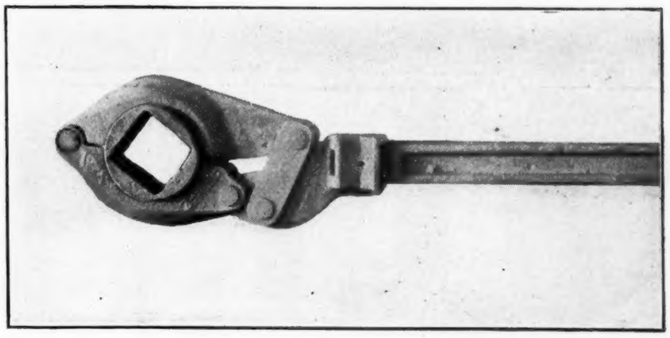
The machine is portable and weighs 230 lb. It is regularly equipped with a ½-hp. heavy duty, 110-220-volt, a.c., 60-cycle, single-phase motor and is operated from an ordinary light socket. Special motor equipment is available for localities where standard equipment is not suited.

Drop-bottom car door safety friction wrench

THE doors of hopper and drop-bottom cars are usually difficult to operate owing to the fact that they are subjected to considerable abuse in service. Consequently, much effort and time is required when dumping or winding up these doors. The Barrett Machine Company, Pittsburgh, Pa., has developed a wrench especially designed for this work, which it is claimed will function under all conditions with a minimum amount of effort and time.

The action of the wrench is secured through an arrangement of a toggle which gives a powerful tightening force in one direction only. The socket, which fits over the end of the car door shaft, is held between two straps which form the head of the wrench. These straps grip the socket when pressure is applied to the wrench handle. The toggle action insures instantaneous release so that the possible chance of the wrench injuring the operator by catching is reduced to a minimum. By the use of the toggle, there are no complicated parts to get out of order and no ball bearings, ratchet heads, pawls or triggers to catch.

No bolts are used in the wrench.


No bolts are used in the Barrett safety friction car door wrench

"Lanco" thread cutting die head

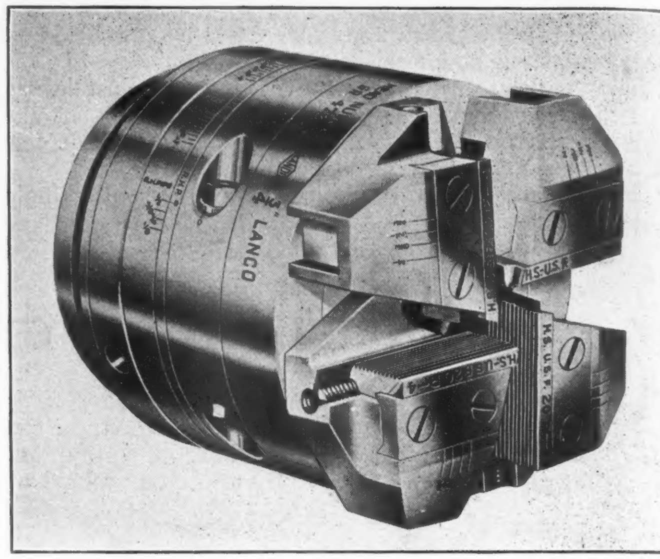
THE Landis Machine Company, Waynesboro, Pa., has placed on the market under the trade name of "Lanco" a new series of thread cutting die heads. The chasers are supported on the front face of the head, which permits easy access when it is necessary to remove them for grinding and when changing from one pitch to another.

The head is made of high carbon steel and is heat

treated throughout, and ground. This construction, together with the compact design of the head, reduces the wear to a minimum and prolongs the life. The head is adjusted to size by means of an adjusting worm. The adjusting worm is under the proper turning tension at all times, thereby eliminating the necessity of locking it for each adjustment of the die head for size. The graduated dial at the end of the adjusting worm gives a variation in adjustment of approximately .005 in. for each graduation. The head, when threading, is locked within itself by the engagement of two closing pins in hardened bushings. It is opened and closed automatically, which is always a desirable feature.

The head is graduated for all sizes of bolts, both right and left hand, and right hand pipe within its range. All passages and openings into the interior of the head are entirely covered under service conditions, making it impossible for dirt and chips to enter, thus prolonging the life of the head.

The head is made in the 3/8-in., 9/16-in., 3/4-in., 1-in. and 1 1/2-in. sizes. It is applicable to all makes of automatic, semi-automatic and hand operated threading machines.



The chasers can be readily removed from the Landis thread cutting die head

Motor driven horizontal pipe bender

HERETOFORE, the pipe benders manufactured by Pedrick Tool & Machine Company, Philadelphia, Pa., have been hand operated but since modern practice looks with more favor on power instead of hand work, this company is now building a pipe bender up to 2 in. in capacity which is especially designed for electric motor drive. A machine of this type is particularly adapted to railway work.

Power driven pipe bending machine with a capacity up to 2 in. inclusive

The face plate is geared to revolve within the cavity of the horizontal table so that the gear teeth are entirely covered and guarded. The bending roll, on the central stud, is bolted stationary and the bending arm, which moves with the face plate, bends the pipe around the roll. The other end of the pipe rests against a small saddle located on the resistance arm. This latter piece has a free radial movement which is held, wherever desired by a dowel pin in holes located in a circle around the face of the table.

This provides an important application because the bending arm and the resistance arm may be brought close together for the purpose of bending short pieces of pipe that have been cut off and, perhaps, threaded. A stop, which is bolted to the face plate, is provided so that any quantity of the same shape may be bent with the assurance that each piece is subjected to a uniform bending movement and consequently will register with the preceding bend when the stop makes contact with a pin suitably located in the holes spaced around the edge of the table.

From this it will be seen that from one size roll almost any shape may be obtained. The roll is grooved for the diameter of the pipe to be bent and governs the radius of the bend. The arc through which the face plate is turned, controls the degree or angle of bend. Hence, a right angle bend is made by revolving the face plate 90 deg., a larger or smaller angle is as easily made accordingly.

In the power driven machine the motor is allowed to run while the machine is in operation and the hand lever affords start, neutral and reverse positions instantly at the wish of the operator. The power drive serves a very useful purpose when quantities of the same shape are to be bent. It works at a uniform speed and without decreased production or the efficiency of the operator at the end of the day.

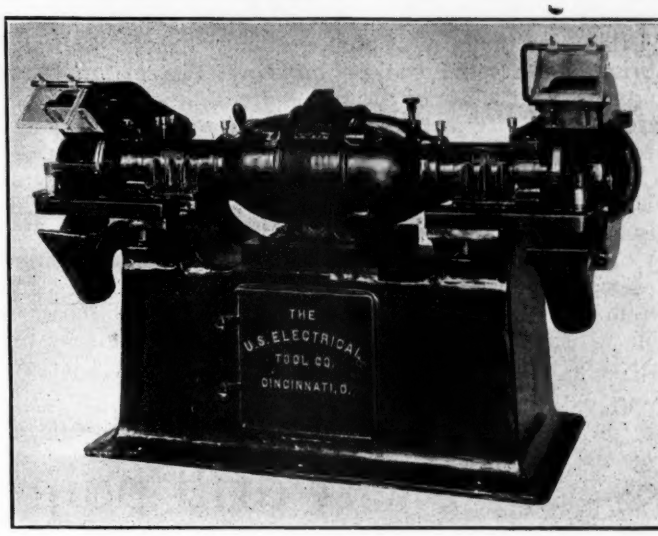
The horizontal table is convenient on which to handle, lay out and measure the work and also permits the bending of long pieces at the middle of the length which is often necessary in hand-rail work, running pipe lines, etc.

Besides the 2-in. power driven machine the manufacturer makes also a hand machine of the same capacity and smaller.

Heavy duty constant speed grinder

A HEAVY duty adjustable speed grinder, suitable for either alternating or direct current, has recently been placed on the market by the United States Electrical Tool Company, Cincinnati, Ohio. These grinders are so designed that the adjustment of the guards of the wheel will automatically regulate the speed of the motor so that the peripheral speed of the wheels is constant regardless of the wheel diameter. When used on direct current, constant peripheral speed can be obtained regardless of the wheel size.

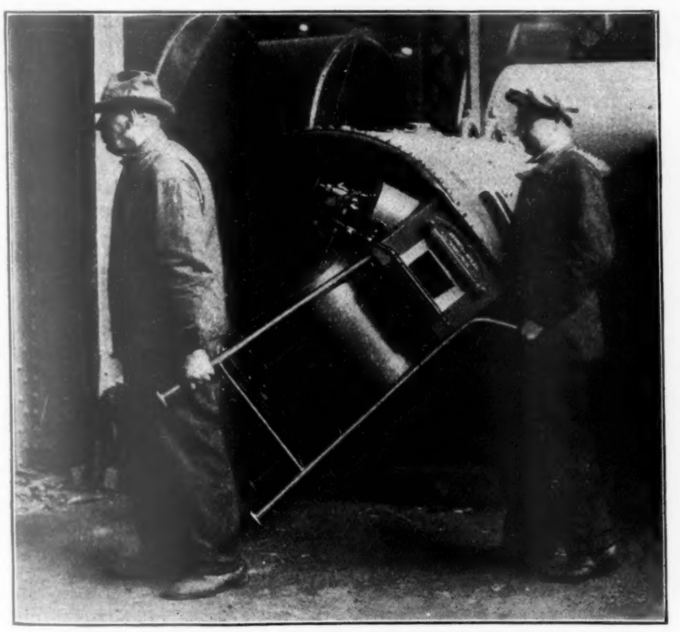
On alternating current, starting with a 24-in. wheel at 900 r.p.m., a periphery of approximately 5,500 ft. is obtained. The wheel can be used until it is worn to 18 in. at which time the next speed of 1,200 r.p.m. will automatically cut in by moving a hand lever which will then bring the periphery up to approximately 5,500 ft. Another change in speed occurs when the wheel is worn to 12 in. which increases the speed of the motor to 1,800 r.p.m. which will then again bring the speed up to approximately 5,500 ft. The alternating current motor on these machines is a three speed motor namely: 900, 1,200 and 1,800 r.p.m.



Constant speed grinder for use with alternating or direct current motors

Light portable oil rivet furnace

AN oil burning, hand portable rivet forge for shops and yards where a forge can be carried most conveniently, has been placed on the market by the Johnston Manufacturing Company, Minneapolis, Minn. It is equipped with the Johnston non-clogging vacuum oil burner, a description of which appeared on page 501 in the August, 1924, issue of the *Railway Mechanical Engineer.*



The Johnston oil rivet furnace can be carried by two men

The hearth of this forge is 40 in. above the floor so that the operator can see the rivets without stooping. The gases from the heating chamber are vented high enough so that they can not be blown by the wind against the workmen. The closed top chamber provides good combustion as the vent gases leave the bottom or coolest part of the heating chamber. The heating chamber is designed to give a rapid motion to the gases which come in contact with the rivets. This chamber is lined with standard sizes of fire brick and is made thicker at the points of maximum temperature. The frame is made of pipe and welded together which gives a minimum weight in proportion to the strength. It is also designed so that it can be readily carried from one job to another by two workmen.

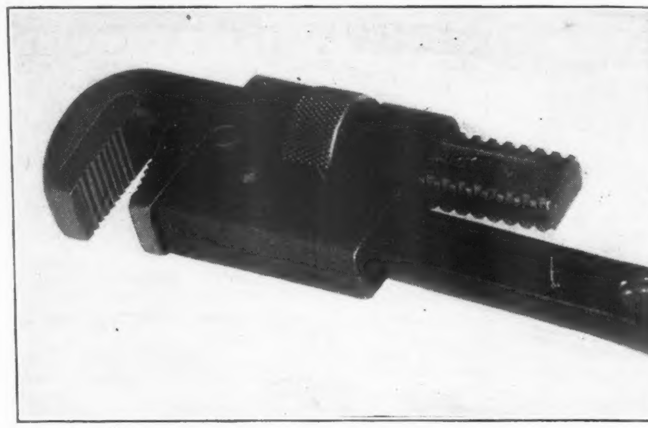
The furnace operates on compressed air between 60 to 125 lb. and burns either kerosene, distillate or fuel oil. It uses six cubic feet of air per minute and burns one gallon of fuel per hour. The fuel tank capacity is 7½ gal. per hour. The heating chamber is 8½ in. by 10 in. and its charging opening 5½ in. by 3½ in. It requires a floor space of 20 in. by 36 in. and weighs 240 lb.

All-steel pipe and monkey wrench

AN all-steel pipe and monkey wrench which has been introduced recently for use in railroad shops and enginehouses is illustrated. Features of this wrench are its construction of accurately machined drop forgings and the application of a removable lower wrench jaw held in place by a thumb screw. The construction is such that the lower jaw pivots slightly on the screw and this movement in conjunction with that of the hook jaw, gives a double action which assures an unusually rigid grip on round pipe or other similar material being turned against resistance. There is a noticeable tendency for the jaws to grip harder the harder the pull, and yet they re-

lease readily as soon as pressure is removed from the handle. Owing to the fact that in operation the jaws adjust themselves so as to be practically parallel, the tendency to crush the pipe is minimized. Another feature of this wrench is the absence of any handle or bridge springs to become lost or broken. The material and rugged construction of the frame are designed to give the wrench long life in the severe service to which wrenches are subjected in railroad shops and enginehouses.

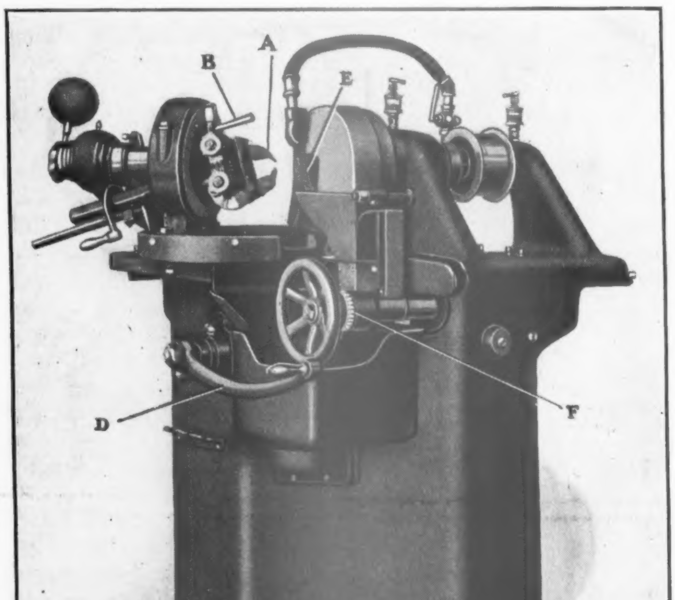
When used as a monkey wrench, the hook jaw is furnished without teeth and a plain inserted main jaw is also applied. For use on pipes, this wrench is provided in 8, 10, 14, 18, 24 and 36-in. sizes, the largest taking 3½-in. pipe. The monkey wrench sizes are 8, 10, 14 and 18-in. All parts of the monkey wrench are interchangeable with the pipe wrench. This wrench is made by the Larco Wrench & Manufacturing Corporation, Chicago.



Larco all-steel wrench with double-acting jaws

Twist drill point grinding machine

A TWIST drill point grinding machine built in two sizes, No. 2 taking drills ¼ in. to 7/4 in. in diameter, and No. 3 taking drills ⅝ in. to 2 in. in diameter, is now manufactured by the Union Twist Drill Company, Athol, Mass. It will sharpen points of twist drills having right-hand spiral flutes and two lips, and will grind them so that the cutting point will have lips that are the same length, with the chisel point coming at the center of drill.



Union twist drill point grinder which will sharpen all types of drills up to 2 in. in diameter

The drill is held by a two-jaw chuck *A*, operated by the lever handle *B*, which gives a rapid movement of the chuck jaws, thus taking a minimum amount of time in chucking the work. The chuck jaws are adjustable laterally so as to give them a clearance angle for different diameters of drills. A graduated plate on the upper jaw gives the setting for different diameters. The jaws can be adjusted vertically to obtain different clearance angles as required. The machine is adjusted, when assembled, to give a clearance angle of 12 deg.

The work spindle is carried in a housing that is adjustable to give various included angles of drill points ranging from 90 deg. to 118 deg. The machine is set to give a 118 deg. included angle of point which has been found to be most efficient for general work.

The work spindle housing is carried by a slide operated by the hand lever *D* so that the point of the drill is moved across the face of the grinding wheel. This slide travels on hardened and ground roller bearings, which permits rapid traverse with a minimum amount of effort on the part of the operator.

The chuck spindle front bearing is carried on hardened and ground steel rollers, and the rear bearing is carried in a bronze box adjustable for wear and adjustable longitudinally so that chuck and spindle can be kept in a correct position relative to the spindle boxes. The chuck spindle has a rotary movement of about 110 deg. and can be varied by setting adjustable screws.

The grinding wheel *E* is of the ring type, 8 in. in diameter, and is held by a flange clamped to the end of the wheel spindle. The wheel head has an adjustment of 4-in. to compensate for the wear of the wheel and allow for moving the wheel to the correct position in relation to the drill. A graduated collar *F* on an adjusting screw provides means for moving the wheel to the same position for grinding both lips of a drill.

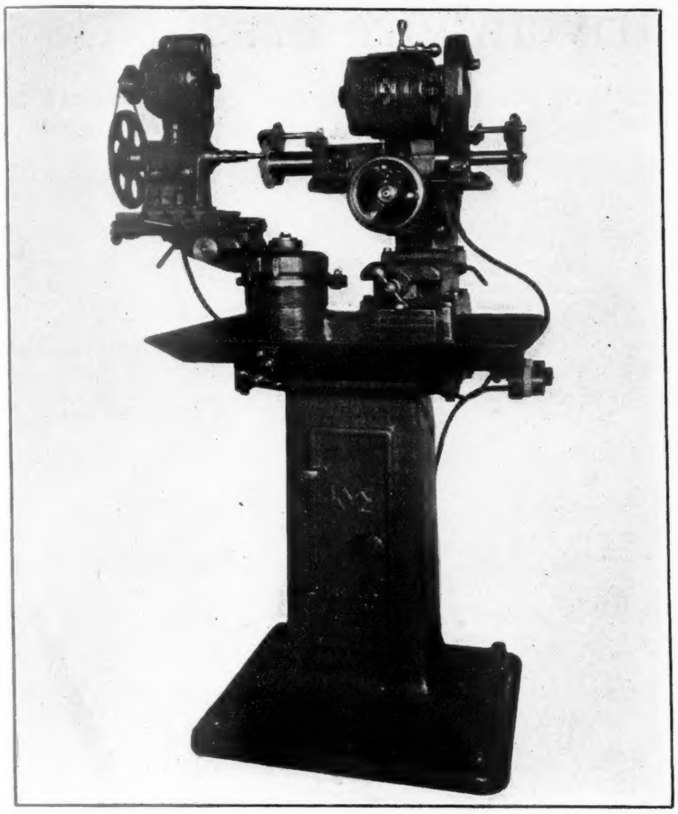
All drills, both high speed and carbon, should be ground wet with an ample supply of water on the work. A pump and tank with suitable piping is provided and supplies a sufficient flow of water to the wheel. The machine is equipped with suitable water or splash guards to protect the workmen.

A diamond holder is clamped in the chuck jaws in the same manner as a drill is clamped, and is traversed across the face of the wheel. This insures that the cutting face of the wheel is parallel with the travel of the drills when they are held in the chuck.

The countershaft has tight and loose pulleys 10 in. in diameter for a 3-in. belt and should run 550 r.p.m. The floor space required for the machine is 45 in. by 40 in. The net weight of No. 2 is 1,580 lb. and No. 3 1,850 lb.

Universal cutter and radius grinder

THE cutter and radius grinder illustrated has been placed on the market by the Keller Mechanical Engineering Corporation, Brooklyn, N. Y. The machine is intended for grinding milling cutters, reamers and similar tools, and is suited for spherical and radius, cylindrical, taper, face, angular form, flute and blade, clearance and back-off, internal and various surface operations.



Universal grinder especially adapted for shaping milling cutters

There are six separate movements on the machine, giving a wide range of adjustments and adaptability to many classes of work. It is possible to grind a desired radius on an end mill or on the corner of a face mill, at the same setting used for the rest of the grinding of the cutter.

The machine is self-contained, driven by two motors, one for the wheel drive and one for the work drive, and it has a spindle speed of 5,100 r.p.m. The ball-bearing wheel spindle is mounted on three slides, giving movement longitudinally, vertically and transversely of 4¾ in. each. The work-holding stretcher is mounted on a turntable so that it can be swung with relation to the wheel in order to grind the radius of the work. A cutter-grinding fixture is furnished for holding mills of all types, and for grinding the tracer points and similar work the cylindrical and face-grinding fixture, equipped with a motor, is provided. Five work speeds are adjusted to suit the work, by means of cone pulleys. The work table travel is 210 deg. angular, 3¾ in. radially and 1⅞ in. cross-slide. The size of the table is 6⅜ in. by 8½ in., and it is provided with three ½-in. tee-slots.

The cutter head can be tilted 45 deg. in either direction and the spindle of the work-holding attachment can be swiveled in a vertical plane and locked in any desired position. The wheels used are ⅜ in. by 4 in. and ⅛ in. by 4 in., either cup or saucer.

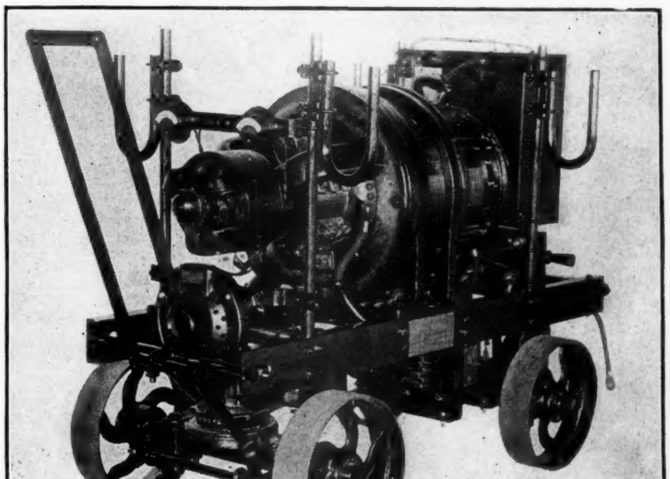
The overall height of the machine is 60 in., and the floor space required is 44 in. by 40 in., the net weight is 800 lb. and, crated for shipment, 875 lb.

Interpoles added to welding generator

THE USL welding generator, manufactured by the U. S. Light & Heat Corporation, Niagara Falls, N. Y., in 200 and 300 ampere capacities is a four-pole self- and separately-excited shunt machine with an all laminated magnetic structure. This type of construction permits a rapid change of magnetism so that the arc will respond quickly to the varying conditions and adjust itself to any demand. Each main pole is provided with two shunt field windings. One set of field coils receives current from a small exciter generator, while the other set is connected to the brushes of the welding generator. The effective flux is produced by the combined action of the self- and separately-excited fields.

In order to provide perfect commutation under severe service conditions the USL 300 ampere arc welder is equipped with four commutating poles. With the addition of these commutating poles perfectly black commutation at any load up to 350 amperes is assured. Maintenance cost and brush wear are therefore a minimum.

The feature of good commutation on machines with variable and fluctuating loads is of utmost importance in view of the fact that instantaneous inherent regulation is most effective on machines with smooth commutators. Another advantage gained through interpoles is the slight compounding action of the interpole flux which results in a steadier and more tenacious arc. This feature will be appreciated by all engineers experienced in the art and application of arc welding. The last advantage is the inherent arc current stabilizing action of the interpole



U. S. L. portable welding outfit

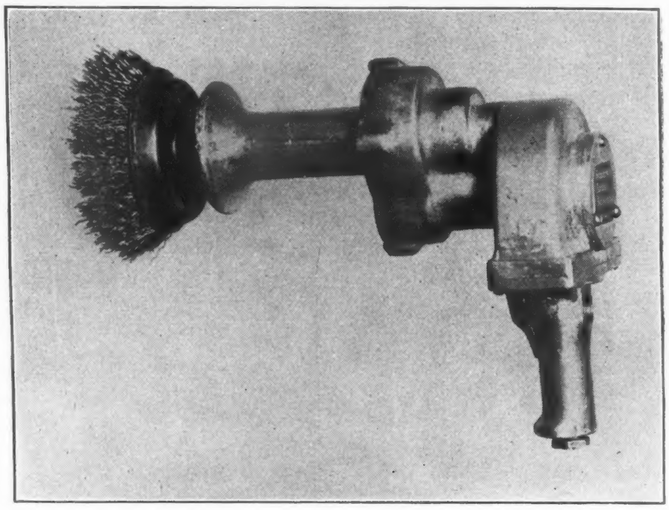
windings. As the interpole windings, being connected in series, always carry the full welding current, a very pronounced internal reactance is set up and to such an extent that under certain conditions the usual external stabilizer may be eliminated. This latter advantage is of decided importance in so far as a reduction in size or the entire elimination of the external reactance results in a higher over-all efficiency of the welding equipment.

Pneumatic turbine-driven wire brush

A PNEUMATIC turbine-driven cable brush for use in cleaning rust preparatory to painting tank and steel freight cars has been placed on the market by the Standard Turbine Corporation, Scio, N. Y. The turbine consists of a wheel operating at a speed of 12,000 r.p.m. mounted on ball bearings and geared to the low speed shaft driving the wire brush.

The low speed shaft is laid in a long sleeve bearing and arranged also with a ball thrust bearing to take up any thrust imposed in applying the brush. The air is admitted to the turbine wheel by means of a valve operated by a trigger. The turbine wheel itself consists of a small steel forging tested to a maximum speed of 100,000 r.p.m. The bearings are grease lubricated, the grease connections being arranged for the alemite system. The exhaust is through the center of the low speed shaft, which assists in keeping the brush clean.

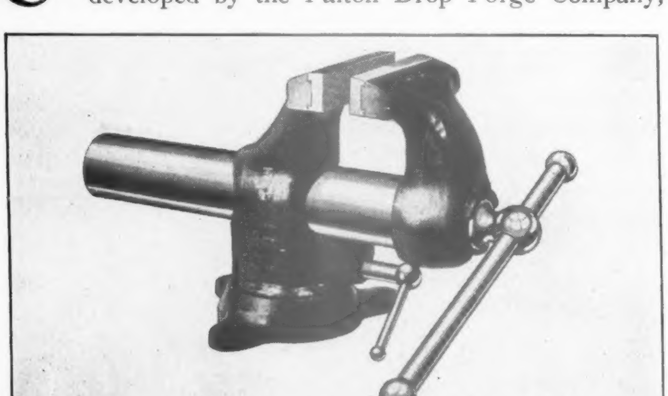
The standing torque of the motor is claimed to be greater for equivalent air consumption than any reciprocating motor used for this kind of work. The no-load speed of the motor is always such as to be less than one-third of the tested safe speed of the wheel. The motor has an all aluminum casing and its total weight is 9¼ lb. without the brush and about 11 lb. with the brush. The motor is free from vibration.



Turbine driven wire brush for cleaning steel cars and tanks

Steel drop forged bench vise

UNDER the trade name of "Dropfo," a vise that is made entirely of drop forgings, has recently been developed by the Fulton Drop Forge Company, Canal Fulton, Ohio. It contains no cast iron parts.



A bench vise made of steel drop forgings

Each part is machined to be interchangeable with the same part on any other vise of the same size. The jaw plates are knurled and forged under the hammer and doweled onto the jaw. Thus, it is possible to replace the jaw plates, which are naturally subject to wear.

The vise is lighter in weight than the cast iron type. It is made with a swivel base and wedge lock that is quick to set and automatic in tightening up, and has a grip that is hard to shake or break loose.

It is made in four sizes: 3 in. with jaws opening 5½ in.; 4 in. with jaws opening 6 in.; 5 in. with jaws opening 8 in., and 5 in. heavy duty with jaws opening 8 in.

STEEL AND ITS HEAT TREATMENT.—The first of a series of articles on steel and its heat treatment, by H. M. Boylston, has been issued by the Republic Flow Meters Company, Chicago. This article gives the reasons for heat treatment; heating and cooling curves of pure iron showing the solidification temperature of iron and the critical temperatures, and inverse rate curves showing the critical temperatures of pure iron.

Portable electric twist drill grinder

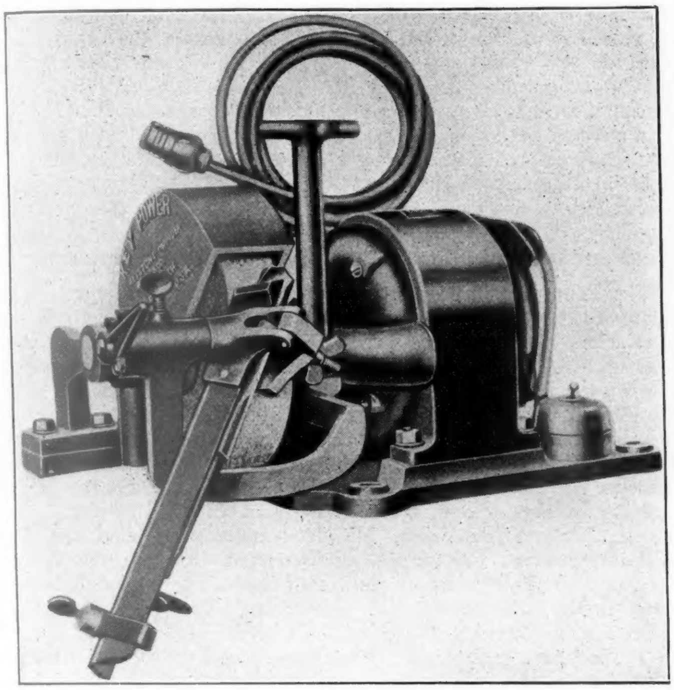
A NEW portable electric twist drill grinder has been designed to produce efficient work at a rapid rate with unskilled workmen. This device, called the "Key-power," is manufactured by the Keystone Grinder & Manufacturing Company, Pittsburgh, Pa.

The grinding action is produced by a light pressure of the drill against the face of the grinding wheel which permits rapid work and prevents burning of the steel or drawing the temper of the tool. The tool or drill is held firmly in place by means of a wedge-shaped toolholder that assures uniform results and eliminates the uncertainty of hand application. No water is necessary during the

grinding process since there is a continuous air circulation on the face of the wheel which contsantly keeps the tool cool.

Railroad repair shops and yards should find this device particularly useful due to its portability; the machine weighing only 60 lb. With it the tools can be ground on the job. A heavy hood over the grinding wheel gives ample protection to the operator.

This electric grinding device is driven by a Westing-



Portable electric twist drill grinder which can be operated by an unskilled workman

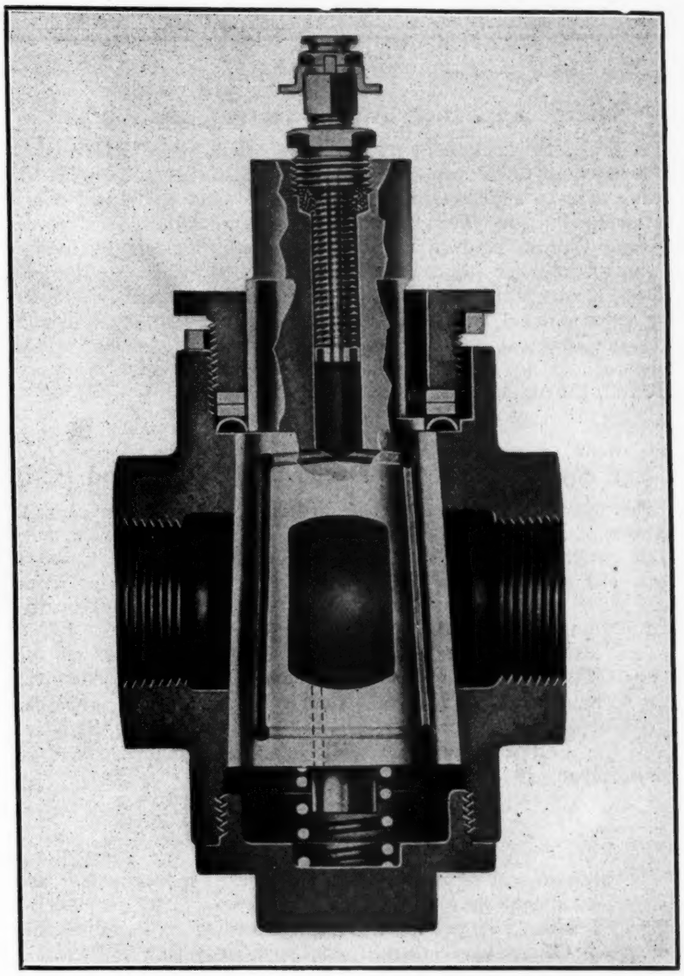
house ¼-hp. motor. An attachment cord enables the machine to be plugged into any ordinary socket. It is capable of redressing all shapes and kinds of edged tools and is fitted for grinding ¼-in. to 1½-in. drills.

Lubricated plug valve

MODIFICATION of a plug valve which was first described on page 1415, in the June 11, 1924, Daily Railway Age, specially designed for steam, air, water, gasoline, kerosene and fuel oil lines in coach yards, general repair shops, enginehouses and terminals, has recently been placed on the market by the Barco Manufacturing Company, Chicago. One-quarter of a turn gives a full pipe area opening through the valve. Since no valve stem is used packing maintenance and sprung or bent stems are eliminated.

The valve is provided with a grease reservoir and lubricating passage ways, as indicated in the accompanying illustration. A lubricator is provided in the plug which prevents the escape of the grease and provides the feeding of the grease to the surfaces of the valve as required. Owing to this feature, the plug and plug seat hold the pressure tight, and the valve operates with ease. The fact that the valve and seat are lubricated at all times greatly reduces wear and replacement. The lubricant may be purchased in tubes ready for use which is usually applied by means of a Barco lubricating gun. If, however, a gun is not available, the grease may be rolled in candle form and applied by hand, after first removing the lubricator.

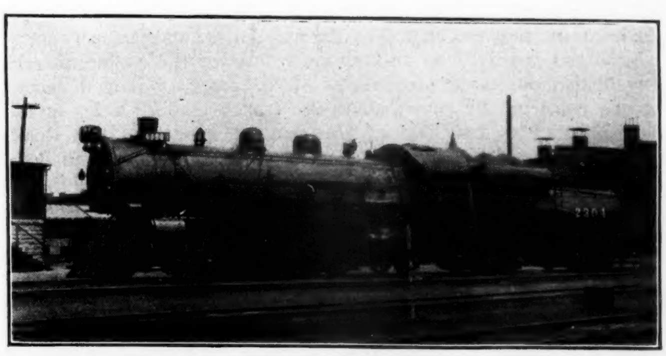
The valves are ordinarily furnished with handles or wrenches, or they may be operated with an ordinary monkey wrench. If wrenches are desired, they may be



Barco Type AC1 lubricated plug valve which opens fully with one quarter turn

obtained in either the standard wrench or the cross wrench. The latter is furnished for valves that are placed in overhead lines, so that they may be operated from below by a slight pull on the opening or closing chains attached to the ends of the handle.

The Type AC1, which is illustrated, will carry the following pressures: Steam, 150 lb.; water, 300 lb.; air, 150 lb. The temperature must not exceed 400 deg. F.



Union Pacific locomotive No. 2304 ready to leave the enginehouse, Cheyenne, Wyo.

General News

Safety Appliance Act—defective hand brake

A brakeman took hold of the wheel of a hand brake to help him to climb to the top of the car to release the brake, when the brake, due to a defect, became loose and spun the wheel round, throwing him to the ground. The Circuit Court of Appeals, Second Circuit, holds that if the brake was incidentally used in going to the point where it was to be released by turning the hana wheel, it was within section 2 of the Safety Appliance Act requiring efficient hand brakes on cars, and the fact that the brakeman was not then using the brake for the purpose for which it was intended did not defeat his right to recover.—Lehigh Valley v. Howell, 6 Fed. *2d*) 784.

Large equipment orders placed by N. Y. C. and M. P.

The New York Central has ordered 4,500 freight cars as follows: 2,000 box from the American Car & Foundry Company; 1,000 gondola from the Pullman Car & Manufacturing Corporation; 500 gondola from the Illinois Car & Manufacturing Company; 500 gondola from the General American Car Company; and 500 gondola from the Standard Tank Car Company.

THE MISSOURI PACIFIC has ordered 3,000 freight cars as follows: 1,000 box, 250 hopper and 250 furniture from the American Car & Foundry Company; 500 box from the General American Car Company; 500 box and 250 automobile from the Standard Tank Car Company; and 250 stock from the Pennsylvania Tank Car Company.

Cost of locomotive fuel

The average cost of coal used as fuel for road locomotives and charged to operating expenses in August was $2.66 per ton, as compared with $2.95 in August, 1924, according to the Interstate Commerce Commission's monthly statement, covering 159 Class I railways, excluding switching and terminal companies and switching locomotives. Fuel oil, however, cost 3.23 cents per gallon as against 2.86 cents last August and the total cost of coal and fuel oil for the month was $26,305,785 as compared with $26,375,435 last August. For the eight months ended with August 31 the total cost of coal and fuel oil was $214,736,375, as against $237,750,593 last year, a saving of approximately $28,000,000 in coal being offset in part by an increase of approximately $5,000,000 in fuel oil.

Record run by oil-electric rail car

On November 4 one of the new oil electric cars of the Canadian National completed a run from Montreal, Que., to Vancouver, B. C., a distance of 2,937 miles in 67 hours. This is the fastest time on record for the run between these points and during the whole of the trip the engine of the car did not once stop running.

Arranged primarily as an endurance test for the engine, the run proved also the speed possibilities of the car over long distances. At one point in Western Canada the car covered 22 miles in less than 22 minutes and one of the steepest grades in the Rocky mountains was climbed at an average speed of 40 miles an hour. The average speed for the entire trip was slightly under 44 miles per hour. This car was described in the November *Railway Mechanical Engineer*.

Wage statistics for August

A summary of the reports of Class I railroads to the Interstate Commerce Commission indicates that the number of railroad employees and the total compensation were greater in August, 1925, than in any month since October, 1924. The total number of employees was 1,800,219, an increase of 4,550 or 0.3 per cent over the returns for the previous month. The total compensation increased $1,371,967 or 0.6 per cent. Compared with August last year there was an increase of 0.6 per cent, while the total compensation increased 3.2 per cent. The percentage difference between the employment and compensation is due to an increase in the number of hours worked per employee coupled with an increase of 0.6 cents in the straight time hourly earnings and 1.5 cents in the overtime earnings.

Pennsylvania announces fuel contest winners

The Pennsylvania has just announced the winners of the highly successful contest for the best paper on fuel conservation which closed last month. There were 75 entrants in the contest, which was open to locomotive enginemen and firemen employed in any one of the three regions of the Pennsylvania. The contest was close in all regions and the committee which had charge of selecting the winners reported that it was difficult to make their decision because all of the papers were interesting, well-written and gave evidence of study and interest in the subject. There were three winners in each region, those in the Eastern region being first, R. H. Thomson, engineer, Maryland division; second, H. P. McLane, fireman, Philadelphia division; and third, J. W. West, fireman, Maryland division. In the Central region the winners were first, John Bruce, Sr., engineman, Panhandle division; second, F. L. Lievig, engineman, Pittsburgh division, and third, C. F. Lockhart, engineman, Pittsburgh division. The winners in the Western region were first, R. W. Karns, engineman, Cincinnati division; second, G. R. Cooper, fireman, Cincinnati division, and third, N. A. Gibson, engineman, Indianapolis division.

American built locomotives popular in South Africa

Record crops this year have found the South African Railways so inadequately equipped with rolling stock and motive power that some of the expresses running between Johannesburg and the coast have had to be temporarily suspended, and the big Baldwin engines recently making new records for the 1,000 miles run have been transferred to the fast freight service, says the Johannesburg correspondent of the Times (London) Trade Supplement. In the effort to relieve the shortage 15 additional locomotives have been ordered from the Baldwin Locomotive Works. Of these 15 new locomotives ten are to be of the Mountain type and five of the Pacific type.

Two of each of these types have been running on the South African Railways for over a month. They were ordered by the Administration on December 15 last. As far as is consistent with South African conditions these locomotives embody the latest American practice.

With the order for the 15 additional locomotives in course of construction at Philadelphia, the Baldwin Locomotive Works will have supplied 79 locomotives to the South African Railways. The first order was placed in 1892. The railways have now 1,862 locomotives and 34,362 cars, an increase since 1909 of 451 locomotives and 11,795 wagons. A total of 54 locomotives are on order, and every month will witness a substantial increase in the capacity of the system for handling the huge traffic with which it now has to cope.

Meetings and Conventions

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting, December 8. Paper on inspection of material for railway purposes will be presented by R. Job, vice-president, Milton Husey Co., Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Courtlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y. Next meeting December 3. Paper on best means of promoting friendly relations between the public and railroads will be presented by Harry F. Burber, plant manager, National Aniline Company, Buffalo. G. C. Woodruff, assistant freight manager, New York Central, Buffalo, will handle the subject from the viewpoint of a railroad traffic officer and R. E. Woodruff, superintendent, Erie, Buffalo, from that of a railroad operating officer.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Cleveland, Public Square, Cleveland. Next meeting December 7. Paper on the value of man power will be presented by S. F. Fannon, Sherman Service, Inc.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Courtlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting December 8. Paper on comparative merit of steam and electricity in railroad operation will be presented by L. K. Sillcox, general superintendent of motive power, Chicago, Milwaukee & St. Paul.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Courtlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 625 Brisbane Building, Buffalo, N. Y. Regular meetings, January, March, May, September and October.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, castor, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August. Next meeting December 11. Papers on the general subject of railroads will be presented by James C. Davis, director general of railroads, and by C. C. Cook, chairman of the Committee on Economics of Railway Labor of the A. R. E. A. Christmas entertainment.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Purchases and Stores meeting

The 1926 annual meeting of Division VI—Purchases and Stores, American Railway Association, will be held at Atlantic City, N. J., on June 9, 10 and 11, coinciding with the first three days of the meeting of Division V—Mechanical. The headquarters of the Purchases and Stores Division will be announced later.

Locomotives installed and retired

	Installed during month	Aggregate tractive effort	Retired during month	Aggregate tractive effort	Owned at end of month	Aggregate tractive effort
January, 1925.	167	7,455,971	213	6,242,079	64,824	2,590,525,478
February	125	6,233,494	169	5,118,878	64,779	2,591,618,849
March	138	6,249,721	170	4,888,933	64,747	2,592,979,637
April	171	7,498,252	409	13,126,135	64,509	2,587,347,354
May	147	7,930,840	172	5,329,461	64,484	2,589,912,779
June	179	9,746,100	224	8,296,659	64,435	2,591,286,720
July	139	7,208,534	170	5,602,619	64,420	2,593,971,635
August	147	8,384,262	210	5,866,368	64,357	2,596,489,549
September	129	7,981,464	229	8,601,871	64,257	2,595,729,142
Total for 9 mos.	1,342	....	...	....	......	....

Figures as to installations and retirements prepared by Car Service Division, A. R. A., published in Form C. S. 56 A-1. Figures cover only those roads reporting to the Car Service Division. Figures of installations and retirements alike include also equipment rebuilt to an extent sufficiently so that under the accounting rules it must be retired and entered in the equipment statement as new equipment.

Passenger cars installed and retired

Quarter	No. installed during quarter	No. retired from service during quarter	No. owned or leased at end of quarter
Full Year, 1923..........	2,719	2,713	......
1924			
Jan.-March	699	431	54,519
April-June	698	552	54,668
July-September	668	544	54,783
Oct.-December	759	849	54,787
Full year, 1924..........	2,824	2,376	......
1925			
Jan.-March	609	589	54,594
April-June	690	644	54,658
Total for 6 months.......	1,299	....	......

Figures from Car Service Division, A. R. A. quarterly report of passenger cars, Form C. S. 55 A. Figures cover only Class I roads reporting to Car Service Division.

Freight car repair situation

Month	Number freight cars on line	Cars awaiting repairs: Heavy	Light	Total	Per cent of cars awaiting repairs
January 1, 1925....	2,293,487	143,962	47,017	190,979	8.3
February 1.........	2,305,520	139,056	47,483	186,539	8.1
March 1...........	2,313,092	141,192	43,855	185,047	8.0
April 1...........	2,315,732	143,329	43,088	186,417	8.1
May 1	2,316,561	144,047	45,467	189,514	8.2
June 1	2,320,261	146,998	48,988	195,986	8.4
July 1	2,326,734	150,530	47,938	198,468	8.5
August 1	2,335,223	153,674	43,607	197,281	8.4
September 1........	2,333,849	149,705	47,473	197,178	8.4
October 1.........	2,335,475	139,551	40,020	179,571	7.7

Month	Cars repaired: Heavy	Light	Total
December, 1924..	66,615	1,288,635	1,355,250
January, 1925...	69,084	1,358,308	1,427,392
February	66,283	1,313,088	1,379,371
March	71,072	1,348,078	1,419,150
April	69,631	1,290,943	1,360,574
May	65,651	1,276,826	1,342,477
June	71,789	1,296,558	1,368,347
July	70,087	1,330,595	1,401,682
August	71,307	1,369,878	1,441,185
September	72,227	1,335,501	1,407,728

Data from Car Service Division reports.

Locomotive repair situation

Month	No. locomotives on line	No. serviceable	No. stored serviceable	No. req. classified repairs	Per cent	No. req. running repairs	Per cent	Total req. repairs	Per cent
January 1, 1925................	64,384	53,118	4,849	5,927	9.2	5,339	8.3	11,266	17.5
February 1	64,308	52,994	4,220	6,143	9.6	5,171	8.0	11,314	17.6
March 1	64,255	52,851	4,988	6,217	9.7	5,187	8.0	11,404	17.7
April 1	64,230	52,619	6,241	6,345	9.9	5,266	8.2	11,611	18.1
May 1	64,034	52,933	6,697	6,082	9.5	5,019	7.8	11,101	17.3
June 1	63,976	53,074	6,618	5,916	9.2	4,986	7.8	10,902	17.0
July 1	63,942	53,025	6,600	5,832	9.1	5,085	8.0	10,917	17.1
August 1	63,921	53,263	6,313	5,740	9.0	4,918	7.7	10,658	16.7
September 1....................	63,812	53,261	5,902	5,514	8.6	5,037	7.9	10,551	16.5
October 1	63,701	53,058	5,337	5,552	8.7	5,091	8.0	10,643	16.7

Data from Car Service Division reports.

Supply Trade Notes

William Jarvis Wickes, president of the United States Graphite Company, Saginaw, Mich., died on November 1, from heart trouble.

F. S. Hartwell has been appointed representative of the Davis Boring Tool Company, St. Louis, Mo., with headquarters at Rochester, N. Y.

Charles B. Ashmead has been appointed sales representative of S. F. Bowser & Co., Inc., Ft. Wayne, Ind., with headquarters at Cleveland, O.

Edward E. Roberts will in future represent, in the western part of New York state, the Firth-Sterling Steel Company, McKeesport, Pa.

Homer D. Williams, president of the Carnegie Steel Company, Pittsburgh, Pa., has resigned to become president of the Pittsburgh Steel Company.

E. K. Conneely, vice-president of the New York Air Brake Company, at New York, has resigned to become vice-president of the Pullman Company.

The Goodell Pratt Company, Greenfield, Mass., has purchased the portable electric drill business of the A. F. Way Company, Inc., East Hartford, Conn.

The Link-Belt Company, Chicago, has awarded a contract to the H. K. Ferguson Company, Cleveland, O., for a one-story, 120 by 260 ft. addition to its plant.

The Sullivan Machinery Company has moved its Sydney, New South Wales, office from Australasia Chambers, 3 Martin Place, to the Kembla building, Margaret street.

Stewart A. Davis, vice-president of the American Sheet & Tin Plate Company, Pittsburgh, Pa., died unexpectedly on November 5, in his home at Pittsburgh, at the age of 58.

Page & Ludwick, Chicago, have been appointed representatives in Illinois for the Magnetic Manufacturing Company, Milwaukee, Wis., and the Thomas Flexible Coupling Company, Warren, Ohio.

James A. Galligan has joined the sales department of the Union Railway Equipment Company, Chicago. Mr. Galligan was formerly vice-president of the Mortimer B. Flynn Coal Company of Chicago.

F. W. Stubbs, formerly mechanical engineer of the Chicago Great Western, has been appointed railroad representative of the A. M. Byers Company, Pittsburgh, Pa. Mr. Stubbs will be located in Chicago.

P. M. Brotherhood, 25 Church street, New York City, has opened an office at 7 Ashland avenue, Buffalo, N. Y., in charge of P. M. Brotherhood, Jr., who was manager of Manning, Maxwell & Moore's Buffalo office.

F. M. Cross, formerly manager of the New York pneumatic tool department of the Ingersoll-Rand Company, has been appointed manager of the pneumatic tool department for the Chicago territory, with headquarters at Chicago.

The Premier Staybolt Company, Pittsburgh, Pa., has appointed the American Railway Appliances Company, Borden building, New York, as its eastern representative, effective at once. The eastern territory includes all railroads tributary to New York.

L. F. Wilson, vice-president of the Bird Archer Company, with headquarters at Chicago, has been promoted to vice-president and general manager, with the same headquarters, and will have jurisdiction over production and operation including sales and service.

H. T. Herr, resident vice-president of the Westinghouse Electric & Manufacturing Company, in charge of the South Philadelphia works, hereafter will direct the general management of the Philadelphia plant and also that of the stoker works at Attica, N. Y.

William M. Zintl, of the advertising sales department of the Curtis Publishing Company, has been appointed director of sales of the paint and varnish division of the paint, lacquer and chemicals department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Scott Donahue, who has been representing the Pollak Steel Company of Cincinnati, Ohio, and the Edgewater Steel Company of Pittsburgh, Pa., with an office at 2615 Grand Central Terminal, New York, has also been appointed Eastern sales representative of the Graham Bolt & Nut Company, Pittsburgh, Pa.

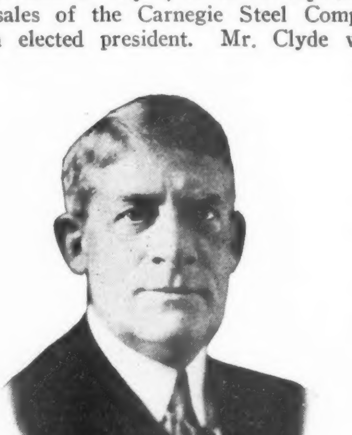
G. W. Mead, president of the Linde Air Products Company, New York, has been elected chairman of the board; W. F. Barrett, vice-president, has been elected president; R. R. Browning has been elected vice-president in charge of sales activities and J. A. Rafferty, vice-president in charge of engineering, manufacturing and research.

M. J. Carney, president of the Prest-O-Lite Co., Inc., New York, has been elected chairman of the board; William F. Barrett, vice-president, has been elected president; Ralph R. Browning has been elected vice-president in charge of acetylene sales activities and R. J. Hoffman, has been re-elected vice-president in charge of storage battery and automotive divisions.

Ward G. Day, for the past seven years in charge of the service department of Fairmont Railway Motors, Inc., at Fairmont, Minn., has been promoted to special agent, with headquarters at New Orleans, La. Mr. Day's jurisdiction will cover the states of Texas, Louisiana, Mississippi, Alabama, Arkansas, Georgia and Florida. Carl Brhel has succeeded Mr. Day at Fairmont.

Henry J. Barnes has been elected vice-president of the Alumino-Thermic Corporation, Roselle Park, N. J. Mr. Barnes has been connected with the Alumino-Thermic Corporation for the past three years. Previous to that time he was for many years in the sales department of the Metal & Thermit Corporation, at the time of his resignation being district manager in charge of Canada.

William G. Clyde, senior vice-president and general manager of sales of the Carnegie Steel Company, Pittsburgh, Pa., has been elected president. Mr. Clyde was born in Chester, Pa., he attended the public schools of Chester and later entered the Pennsylvania Military College graduating with the class of 1888. He began work as civil engineer with Ryan & McDonald, constructors, of Baltimore, Md., and later became associated with Robert Wetherill & Co., machinists and founders of Chester. Mr. Clyde began his mill training with the Wellman Steel & Iron Company at Thurlow, Pa., as superintendent of the plate mills, subsequently going to the Illinois Steel Company, at South Chicago, where he remained for six years. He was then appointed sales manager for the American Steel Hoop Company at Philadelphia, remaining in that position until this firm was taken over by the Carnegie Steel Company. After serving three years in sales work at the Cleveland office Mr. Clyde was appointed assistant general sales manager of the Carnegie Steel Company, with headquarters at Pittsburgh, and in March, 1918, he was made vice-president and general manager of sales of this company.



W. G. Clyde

Four General Electric Company men were killed and two were injured in the train wreck which occurred on the Pennsylvania Railroad near Plainsboro, N. J., on November 12. The dead include R. D. Reed, a member of the General Electric industrial department and in charge of the sale of electric arc welding equipment; Mark A. Atuesta and Arthur W. Gross, members of the manufacturing department, and John C. Horstman of the manager's staff at the Schenectady plant. Among the injured were D. H. Deyoe of the industrial engineering department of the

company and Thomas Wry of the Lynn River works. All the men had met in Baltimore in connection with the Inter-works welding committee of the General Electric Company and were en route to the Bloomfield plant when the accident occurred.

J. H. Whiting, president and treasurer of the Whiting Corporation, Harvey, Ill., has been elected chairman of the board. Col. T. S. Hammond, who for many years has been vice-president and secretary, succeeds Mr. Whiting as president and treasurer. R. A. Pascoe succeeds Col. Hammond as secretary. R. H. Bourne succeeds Col. T. S. Hammond as president of the Grindle Fuel Equipment Company, a subsidiary of the Whiting Corporation, continuing also as vice-president and sales manager of the Whiting Corporation. N. S. Lawrence, vice-president and assistant sales manager of the Whiting Corporation, is also president of the Swenson Evaporator Company, another subsidiary of the Whiting Corporation. J. H. Whiting will remain actively engaged in the business, and no change of policy is involved on the part of the Whiting Corporation and its two subsidiaries.

Benjamin B. Greer, chief operating officer of the Chicago, Milwaukee & St. Paul, with headquarters at Chicago, has resigned. Mr. Greer has been elected president and a director of the New York Air Brake Company, New York, to succeed Charles A. Starbuck, who died on May 29. Mr. Greer was born on August 6, 1877, at Chicago, and began his business career with the Pullman Company in the summer of 1899. A few months later he entered the service of the Great Northern at St. Paul, Minn., as a clerk in the accounting department, after which he was successively material clerk in the superintendent's office, extra gang foreman, assistant roadmaster, chief clerk to the division superintendent and assistant superintendent, with headquarters at Minneapolis, Minn. Mr. Greer left the Great Northern in December, 1908, to become transportation inspector on the Chicago, Burlington & Quincy, with office at Chicago. He was promoted in 1910 to superintendent of the St. Louis terminal. In May, 1911, he became superintendent of the Hannibal division, and in January, 1912, was transferred to the St. Joseph division. In 1913, he was promoted to assistant to the general manager of the Lines East of the Missouri River, with headquarters at Chicago, and the following year he became assistant general manager of the Lines East. From 1915 to July, 1916, he was assistant general manager of the Lines West and then became assistant to the vice-president in charge of operation, which position he held until September, 1917, when he was elected vice-president and general manager of the Colorado & Southern. In November, 1917, he was also elected president of the Colorado Springs & Cripple Creek, with office at Denver, Colo., resigning these positions later in that year, to become assistant regional director of the Central Western region. In November, 1919, he was appointed federal manager of the Chicago, Milwaukee & St. Paul, the Ontonagon and the Escanaba & Lake Superior. On the termination of federal control in February, 1920, he became vice-president in charge of operation of the Chicago, Milwaukee & St. Paul, and subsequently served under the receivership as chief operating officer.

B. B. Greer

The Yates-American Machine Company has been organized through the consolidation of the P. B. Yates Machine Company, Beloit, Wis., and the American Woodworking Machine Company, Rochester, N. Y. J. E. McKelvey, president of the American Woodworking Machine Company, and P. G. Farrow, vice-president and general manager, C. E. McQurston, treasurer, and F. R. Smith, secretary, of the P. B. Yates Machine Company, will retain their respective positions in the new company. H. A. Von Oven, one of the trustees of the P. B. Yates Machine Company, who has been acting president since the death of P. B. Yates, has resigned.

Trade Publications

G-E FLOW METERS.—Electrically operated flow meters for measuring steam, water, oil, gas, etc., are illustrated in a four-page bulletin issued by the General Electric Company, Schenectady, N. Y.

ELECTRIC TRAMRAILS.—"Mr. Keen Kompetitor" is the title of a brochure being issued by the Cleveland Electric Tramrail Company, Wickliffe, Ohio, showing the electric tramrail as it is used in various industrial shops for the moving of heavy loads.

FIRE BRICK CEMENT.—The uses of Adamant firebrick cement in the building of natural gas-fired boiler and oil-burning welding furnaces and in the furnaces of a mill and lumber company are described in three illustrated folders issued by the Botfield Refractories Company, Philadelphia, Pa.

DAILY RECORD CHART.—A full-size reproduction of the daily record chart produced by the Twin Type meter has been issued in folder form by the Esterline-Angus Company, Indianapolis, Ind. The Twin Type meter elements are the same as those used in single meters, but two records, synchronized as to time, are produced on one chart.

STEEL TAPED CABLE.—"The story of steel taped cable" is the title of a 24-page booklet issued by the Okonite Company, Passaic, N. J. The construction of the steel taped cable is shown in detail in this booklet, and a few of the manifold uses to which it may be put are pictured. Specifications and tables for cables of various voltages also are given.

FORGING MACHINERY.—A 10½-in. by 13½-in. book containing 20 pages of illustrated matter descriptive of the second exposition of National forging machinery recently held at Tiffin, Ohio, has been prepared by the National Machinery Company, Tiffin. This book is intended to bring the exposition to those who were unable to attend, and shows the progress in National machine forging equipment.

WALL CHART OF TOOL STEELS.—A 12-in. by 18-in. wall chart descriptive of the various grades of Vasco tool steels, the purpose for which each grade is particularly adapted, the proper heat treatment, etc., is being distributed by the Vanadium Alloys Steel Company, Latrobe, Pa., to toolroom foremen, master blacksmiths, purchasing agents and other mechanical executives interested in this tool steel.

TEXROPE DRIVE.—Bulletin No. 1228, entitled "Allis Texrope Drive," has been issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis. After a brief summation of the advantages of the Texrope drive, its application is described and a graph for determining sheave diameter or distance between centers given. The method to be followed in laying out an Allis Texrope drive is then explained.

GRINDING MACHINERY.—Bulletins Nos. 84, 100, 120 and 174, descriptive of heavy duty face grinders, radial grinders, motor-driven buffing lathes and motor-driven floor grinders, respectively, have been issued by the Bridgeport Safety Emery Wheel Company, Bridgeport, Conn. The face grinder with a 32-in. sectional grinding wheel is designed for grinding guide bars and flat surfaces; the floor grinders and buffing lathes are of the heavy duty series, and the radial grinders are without belts, countershafts, or overhead suspension and operate in or out, up or down, on horizontal surfaces or surfaces at any angle and completely around their bases.

BRIDGEPORT BRASS.—In commemoration of its sixtieth anniversary, the Bridgeport Brass Company, Bridgeport, Conn., has had reprinted and is distributing in pamphlet form an account of its development from 1865 up to the present day. Following an outline of the personnel of the company in 1865, the first American micrometer as it was originated in the shop of the Bridgeport Brass Company is described, and its subsequent development illustrated. Interesting references are made to the early use of brass in hoop skirts, clock parts, lanterns, telephone parts, condenser tubes, trolley wires, etc. The facilities now used in the Bridgeport shops for the production of sheet brass from copper and zinc are then pictured and several of the operations described.

Personal Mention

General

JAMES PAUL has been appointed assistant superintendent of motive power of the Atlantic Coast Line, with headquarters at the Uceta shops, Tampa, Fla., in charge of mechanical forces on the third division, and reporting to the superintendent of motive power, at Waycross, Ga.

Master Mechanics and Road Foremen

W. R. WITHERSPOON has been appointed master mechanic of the Atlantic Coast Line, with headquarters at High Springs, Fla., succeeding James Paul.

R. B. TOMLINSON has been promoted to assistant road foreman of engines of the Virginia division of the Seaboard Air Line, with headquarters at Raleigh, N. C.

F. H. GREENE, air brake foreman of the Moncrief shop of the Atlantic Coast Line, at Jacksonville, Fla., has been promoted to night foreman of the Waycross, Ga., enginehouse.

W. P. KERSHNER has been appointed master mechanic of the Central Kansas division of the Missouri Pacific, with headquarters at Osawatomie, Kans., succeeding S. L. Landis, promoted.

A. B. WILSON has been appointed assistant master mechanic of the Western division of the Southern Pacific, with headquarters at West Oakland, Cal., in place of H. J. McCraken.

D. R. DAVIS, traveling engineman of the Panhandle division of the Pennsylvania, has been promoted to assistant road foreman of engines of the Panhandle division, with headquarters at Columbus, Ohio.

C. L. GIBSON has been appointed master mechanic of the Portland division of the Southern Pacific, with headquarters at the Brooklyn shops, Portland, Ore., succeeding D. M. McLaughlin, who has retired.

S. A. WELTEN, acting assistant road foreman of engines of the Eastern division of the Pennsylvania, has been promoted to assistant road foreman of engines of the Eastern division, with headquarters at Pittsburgh, Pa.

A. HOWARD has been promoted to assistant road foreman of engines of the Fifth and Sixth districts of the Union Pacific, with headquarters at Cheyenne, Wyo., succeeding H. L. White, who has been assigned to other duties.

H. J. MCCRAKEN, assistant master mechanic of the Western division of the Southern Pacific at West Oakland, Cal., has been promoted to master mechanic of the Stockton division, with headquarters at Tracy, Cal., succeeding C. L. Gibson.

W. H. SMITH, assistant road foreman of engines of the Eastern division of the Pennsylvania at Pittsburgh, Pa., has been promoted to road foreman of engines of the Wheeling division, with headquarters at Wheeling, W. Va., succeeding O. B. Hays, deceased.

F. R. BUTTS, assistant master mechanic of the Brookfield division of the Chicago, Burlington & Quincy, at Hannibal, Mo., has been promoted to master mechanic of the Brookfield division, with headquarters at Brookfield, Mo., succeeding H. H. Urbach, transferred.

Shop and Enginehouse

V. B. WEBB has been promoted to night enginehouse foreman of the Southern, with headquarters at Spencer, N. C.

J. S. FLOWE has been promoted to night enginehouse foreman of the Southern, with headquarters at Greensboro, N. C.

GEORGE F. MOSBY has been promoted to assistant enginehouse foreman of the Southern, with headquarters at Birmingham, Ala.

R. KLING, division foreman of the Missouri Pacific at Omaha, Nebr., has been appointed general foreman, with headquarters at Falls City, Nebr.

C. J. THOMPSON, night enginehouse foreman of the Missouri Pacific at Falls City, Nebr., has been appointed division foreman, with headquarters at Omaha, Nebr., succeeding R. Kling.

Purchasing and Stores

G. HARRY HOPKINS has been promoted to assistant storekeeper of the Atlantic Coast Line, with headquarters at High Springs, Fla.

J. H. SMITH has been appointed division storekeeper of the Southern, with headquarters at Atlanta, Ga., succeeding G. A. Blackwell, deceased.

D. W. METZDORF has been appointed acting general storekeeper of the Alaska Railroad, with headquarters at Anchorage, Alaska, succeeding Robert Huntley, who has resigned.

C. F. MONROE, foreman storehouse labor gang of the Atlantic Coast Line at Florence, S. C., has been promoted to assistant storekeeper, with headquarters at Savannah, Ga.

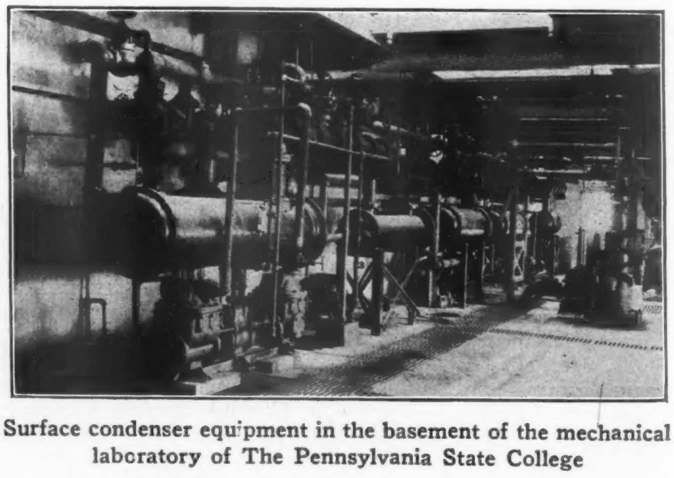
J. L. COWAN, formerly purchasing agent of the San Antonio & Aransas Pass, has been appointed tie and timber agent of the Southern Pacific lines in Texas and Louisiana, with headquarters at Houston, Tex., succeeding J. S. Wickett, who has resigned.

Car Department

E. H. WEIGMAN has been appointed master car builder of the Kansas City Southern, with jurisdiction over the entire line and headquarters at Pittsburg, Kan., succeeding J. Gutteridge, who has been assigned to other duties. Mr. Weigman was born at DeSoto, Mo., July 29, 1892. In 1909 he entered the service of the Louisville & Nashville at East St. Louis, Ill., as a car repairer. He was later promoted to supervisor of the car department, with headquarters at Louisville, Ky., in which position he remained for eight years. For a period of six months in 1917, Mr. Weigman was assistant secretary of the old American Railway Master Mechanics' and Master Car Builders' Associations, under Jos. W. Tayler, secretary. For four years he was connected also with the Atlantic Coast Line as a traveling instructor in the car department, his headquarters being at Wilmington, N. C.

Obituary

THOMAS S. DAVEY, shop superintendent of the Erie at Dunmore, Pa., died recently at his home at Scranton, Pa. Mr. Davey was born on March 11, 1876. In May, 1893, he entered the employ of the Delaware, Lackawanna & Western as a machinist apprentice. He finished his apprenticeship in May, 1898, and in August of that year joined the forces of the New York, Susquehanna & Western as a machinist. On March 1, 1900, he was promoted to gang foreman, and on April 1, 1901, became a machinist at Jersey City. On July 3, 1904, he returned to Stroudsburg as general foreman, and on January 1, 1911, was appointed master mechanic. On August 10, 1914, he became shop superintendent at Buffalo, N. Y.; on November 26, 1917, master mechanic at Secaucus, N. J., and on July 27, 1918, shop superintendent at Hornell, N. Y. On February 3, 1923, he was assigned to special work on crucible steel at Harrison, N. J.; on July 31, 1923, assigned to special work at Hornell and on January 7, 1924, was appointed shop superintendent at Dunmore.



Surface condenser equipment in the basement of the mechanical laboratory of The Pennsylvania State College